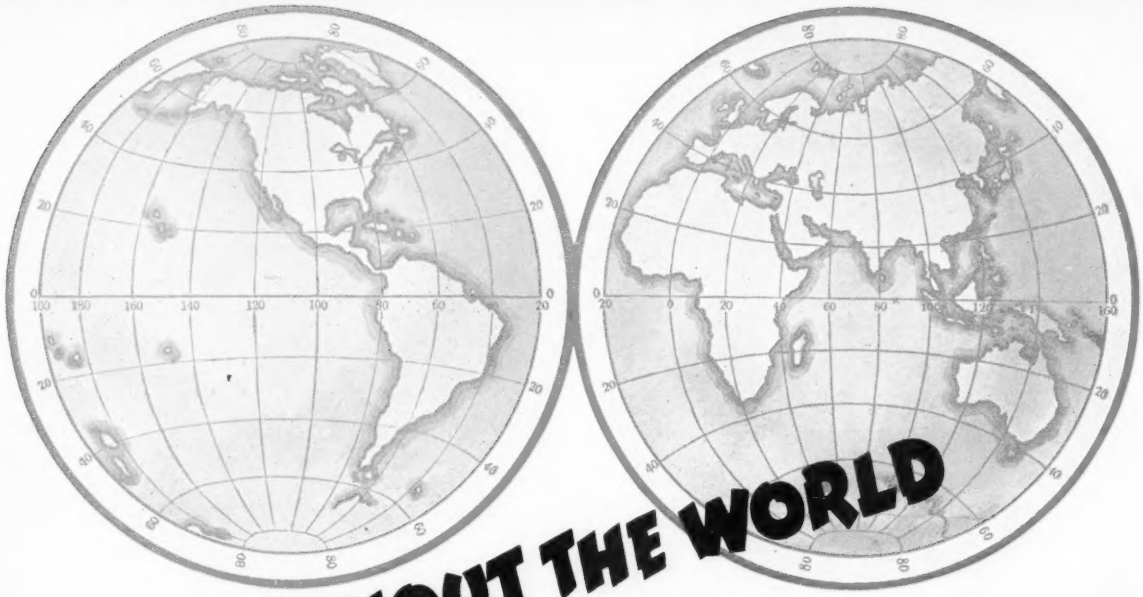
WIRE AND WIRE PRODUCTS

MAY 1938



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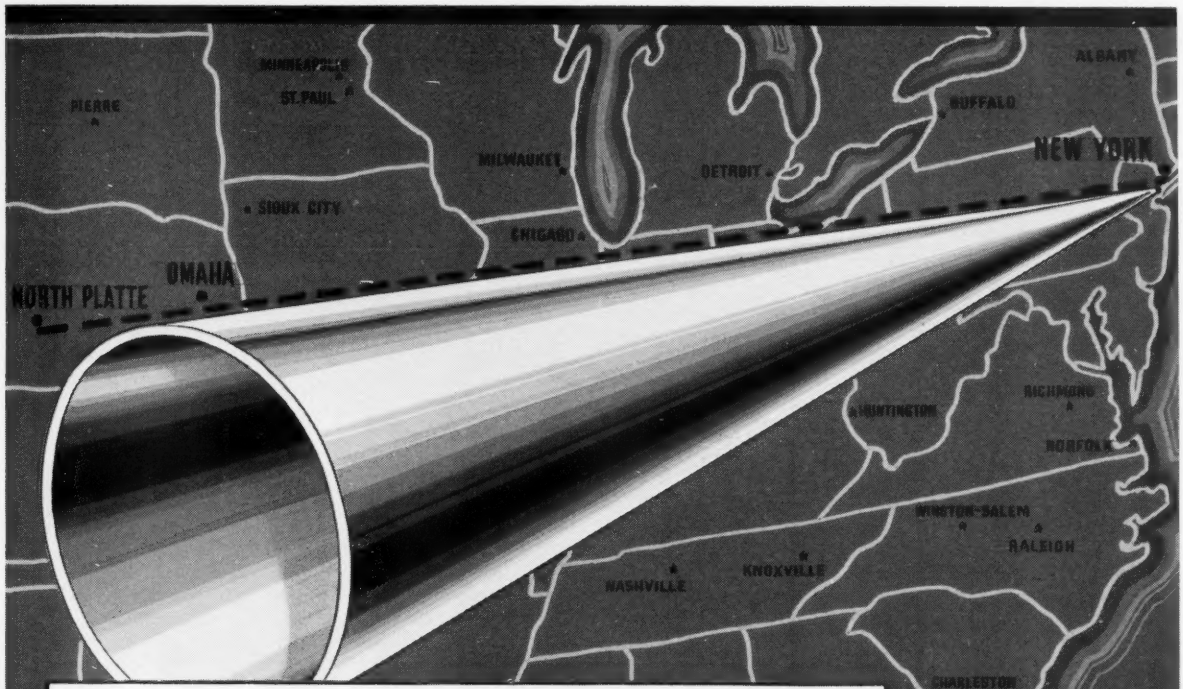

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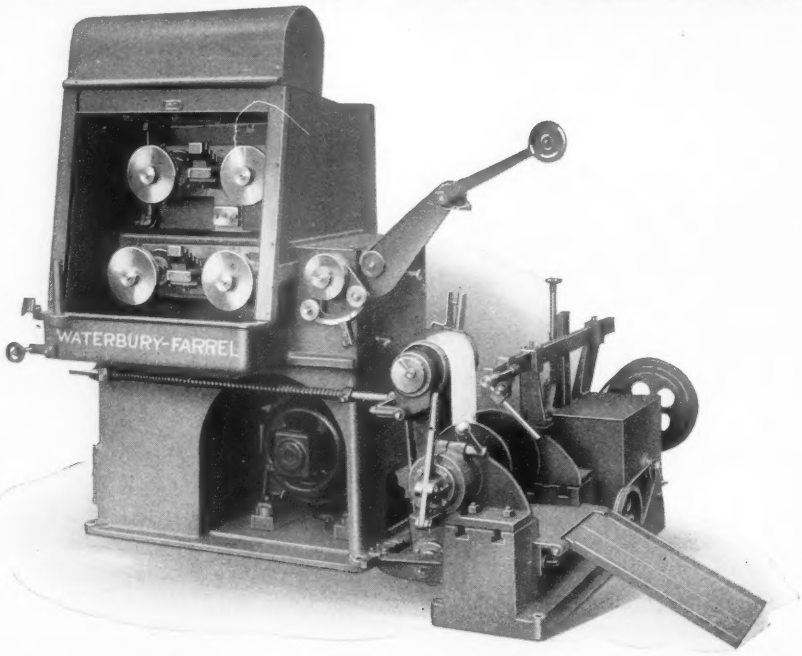

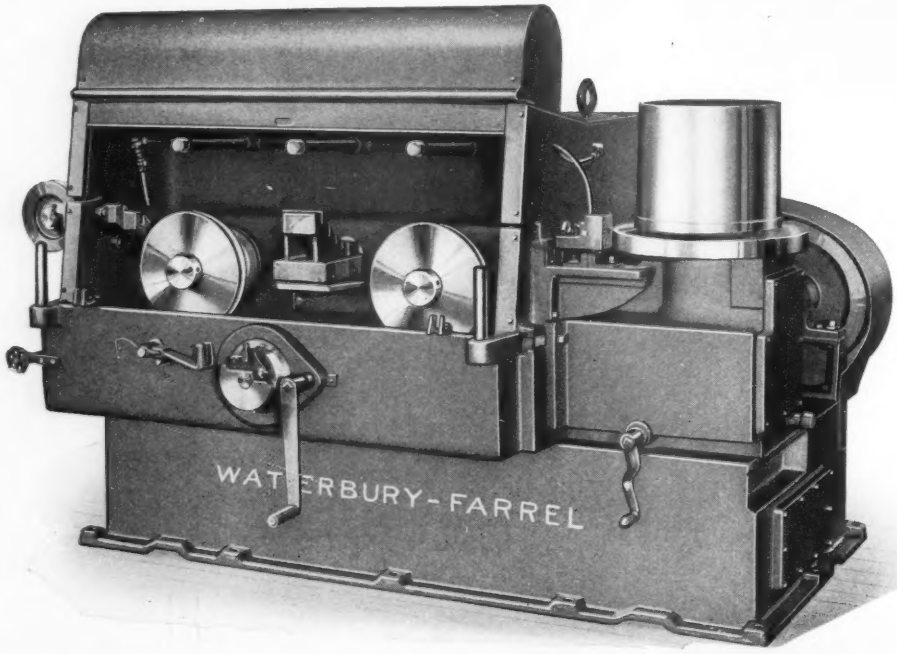

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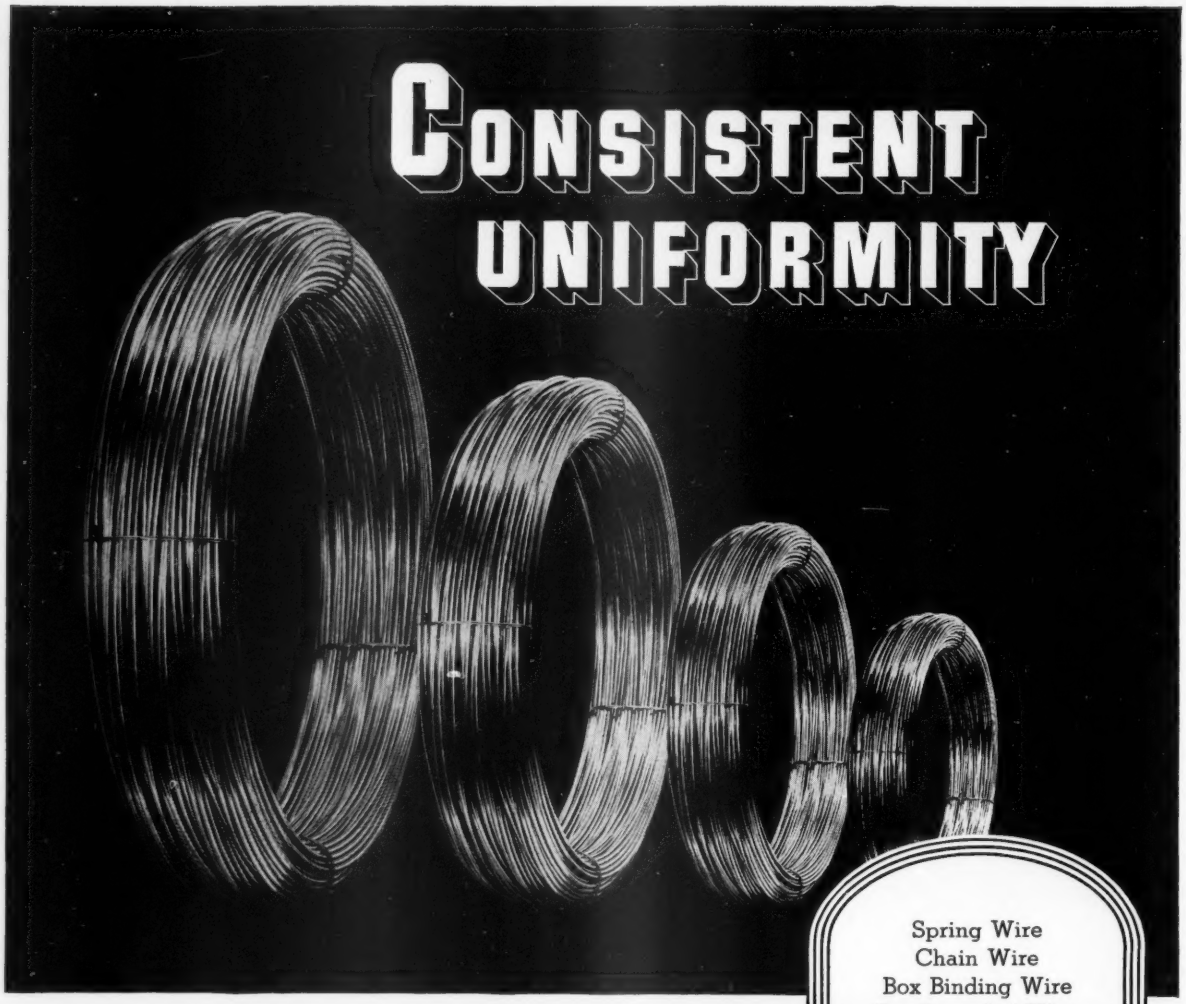

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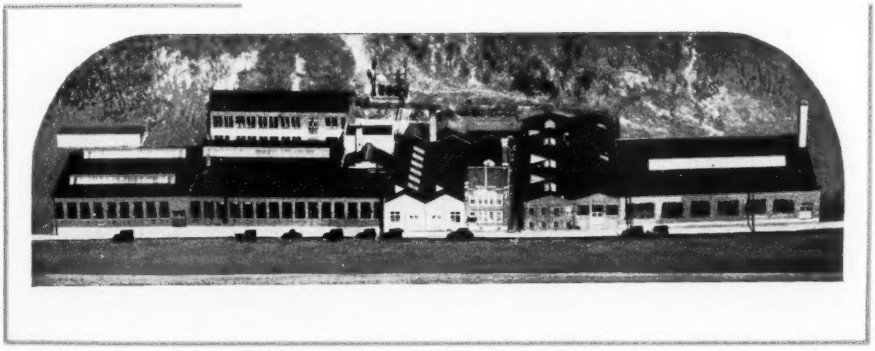

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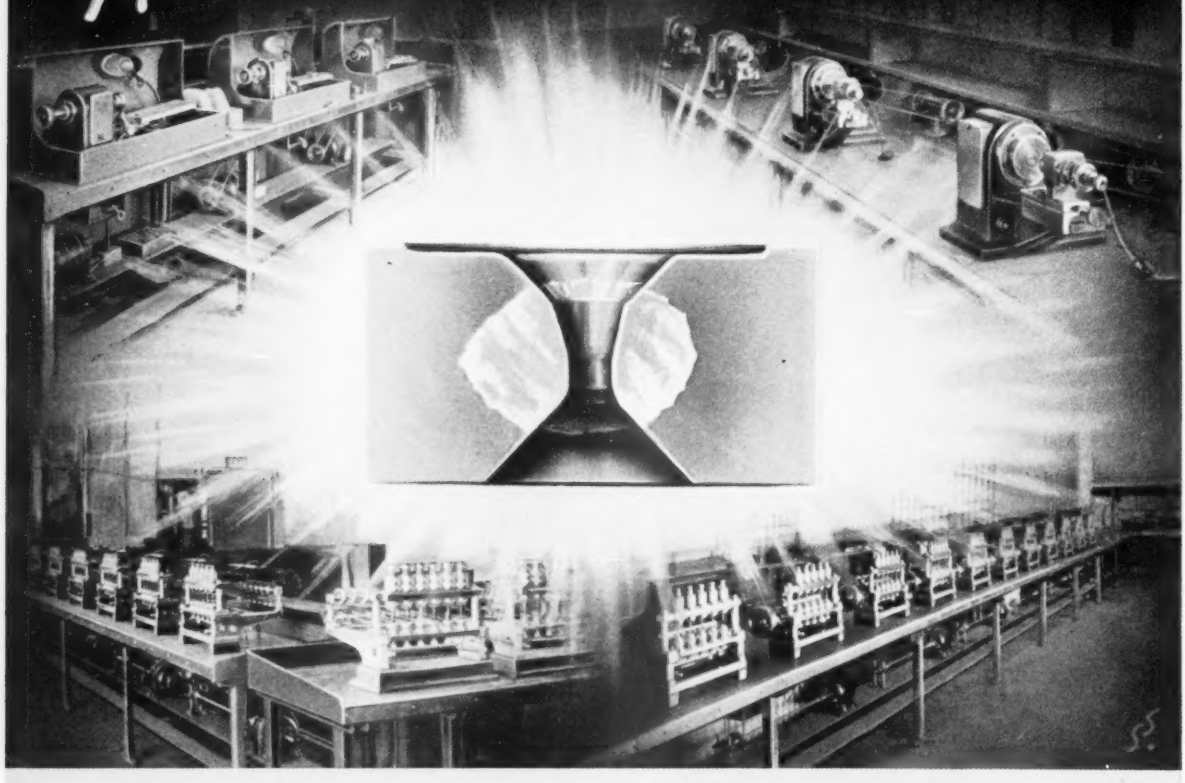

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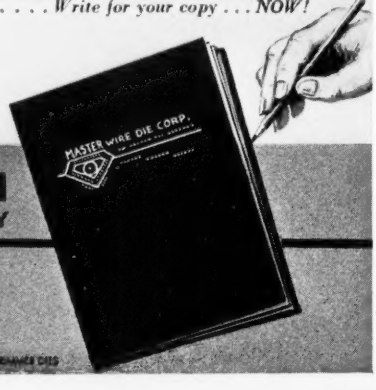

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A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 13 MAY, 1938 No. 5

Designated as

Official Publication By The Wire Association

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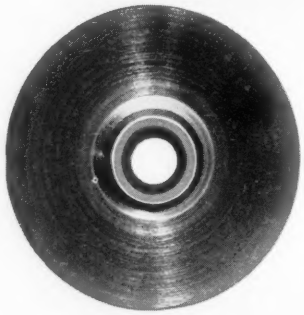

A prominent wire manufacturer who has used Firthaloy wire drawing dies for several years gives us the following service report, covering wire drawn through two typical R-5 Firthaloy Wire Dies:

These two dies were put into service drawing low carbon wire on April 19th, 1934, and they are still going. They were "ringed" so little and worn so slightly that they were used for practically all the split gauges on the way up, as shown by the following table:

GAUGE	WEIGHT DRAWN Pounds
14½	94,330
14	* 69,770
13	93,350
12½	110,930
12	127,415
11½	* 64,220
11	131,755
10½	* 67,105
10	91,335
9½	* 59,130
8½	381,910
8	* 439,025
7½	460,355
7	347,370
6	250,905
5	478,070
4	277,145
3	784,550
2¾	139,450
2½	343,091

*Recut before dies went off size.
After drawing 4,811,211 pounds of wire they are still in service.

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 13 MAY, 1938 No. 5

The Function of A Wire Mill

By S. A. Braley, Ph.D.,

Pittsburgh Steel Company Fellow Mellon Institute of Industrial Research

THE production of wire for years past has been used primarily in such fabricated products as fence and nails, and for such uses only little attention was paid to the absolute quality of the material. However, with the inventive genius of production and fabricating engineers requirements were changed materially so far as particular properties are concerned.

✦ ✦ ✦

Technical Developments

THE time is not far past when the wire drawer punched his own dies, cleaned and limed his own rods, compounded his own lubricants and was held responsible for the wire production. Today each of these operations requires technical supervision, since definite chemical analyses of steel, grain size and physical properties are specified. This condition then requires the correlation of these properties and a careful set-up of operating procedures if they are to be maintained.

✦ ✦ ✦

THESE conditions exist not only in wire but many other mill products as well; e.g., enameling sheet stock formerly was used with extreme difficulty by firing three or four coats of enamel. Due to an increasing knowledge of enameling frits it is now possible to do a one coat job, but to accomplish this it has been necessary to change the method of production of the sheet stock, demanding more rigorous specifications and control.

The purpose of this paper is to present some facts and ideas which may be of value to both the producer and fabricator of wire and wire products. ✦ ✦

This paper was presented at the Regional Meeting of the Wire Association at Pittsburgh, Pa., April 1, 1938. ✦ ✦ ✦ ✦

S. A. BRALEY

Received A. B. degree at Morningside College in 1913, A. M., University of Illinois 1915, PhD., University of Illinois 1917. Instructor and Assistant Professor of Chemistry, University of Illinois 1917-1927, Pittsburgh Steel Company Fellowship at Mellon Institute of Industrial Research 1927 to date. Member, American Society for Metals, Wire Association.

✦ ✦ ✦

Hot Galvanizing of Wire

A DIRECT comparison to enameling exists in the hot galvanizing of wire in that the composition of the base metal is of extreme importance. A necessary development has arisen in this field because of the requirement for heavier, non-peeling coatings. True enough, large quantities of spelter will adhere to a piece of wire as long as it is not greatly flexed, but much wire that is produced for fabricating purposes must withstand extreme flexing, even to being wrapped on its own diameter. As an illustration of this difference in base metal analysis I am calling your attention to this specimen composed of seven grades of steel wire which have been welded together and galvanized (Figure 1).

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The progressive improvement of the galvanizing is very apparent.

✦ ✦ ✦

WE may reasonably ask why there is such a difference in the adherence of the zinc. I believe it is understood generally that galvanizing results from a chemical reaction between iron and zinc; the term implying galvanic action. Let us consider then the factors which influence chemical reactions. First, temperature, secondly, time, and thirdly, chemical reactivity.

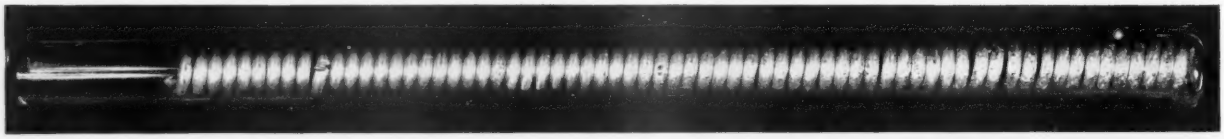

Figure 1.

✦ ✦ ✦

The first of these, temperature, as we all know, is an important factor from the production standpoint; high temperatures cause excessive dross formation both on the wire and on the spelter pan and also result in a greater heat loss and hence higher production costs. Necessarily a temperature high enough to melt the zinc and produce the necessary fluidity is required but the most desirable condition is to maintain the lowest temperature possible.

✦ ✦ ✦

THE second item, time, is again a production factor since an increased time of immersion of the wire in the spelter either means slower speed or excessively long spelter pans.

✦ ✦ ✦

THE third condition, chemical reactivity, then becomes the all important controlling factor. This is evident since if the chemical reactivity is high a short time and a low temperature is sufficient but if the reactivity is low a high temperature or a long time or both may be necessary.

✦ ✦ ✦

Evaluating Chemical Reactivity

WE should then be able to devise some method of evaluating chemical reactivity. Since all rods prior to drawing into wire are pickled we will look at the rate of action of acid on the base metal. Table A represents the rate of metal loss in uninhibited 6% sulphuric acid for a period of 30 minutes. Results are expressed in milligrams per square centimeter.

✦ ✦ ✦

THESE are all rimmed steels; if killed steels be used the losses will increase, as the surface of the material will then be of more nearly the average composition instead of the more pure rimmed material. While these materials are not the same as those in the specimen exhibited a comparable condition would result from these samples. The same ladle analysis of steel can be satisfactorily galvanized from a killed stock at a lower temperature than from a rimmed stock. This type of information then permits of producing material of specified physical properties and galvanized coating adapted to the fabricating process in which it is to be used.

✦ ✦ ✦

Telephone Wire

THIS factor is very important in the production of telephone wire where maximum resistances are specified, because such wire also requires a type of galvanizing that will withstand wrapping on its own diameter. Resistance again is directly proportional to composition, at least in this range of analysis and hence can be calculated. Thus a specification can be readily set which will meet each of these requirements.

✦ ✦ ✦

IT should be noted also that the steels which have the higher chemical activity and hence better galvanizing quality also are those of such composition as to give greater tensile strengths in the wire. Thus the values expected from these steels in an annealed and galvanized wire would range from 45,000#/sq. in. on the first sample to c/a 70,000#/sq. in on the latter. These values assume a good furnace or lead annealing. Thus again a correlation of properties permits of adjustment of these properties to the specification required.

✦ ✦ ✦

Manufacturers' Wire

THIS question of physical properties and chemical composition again is one of utmost importance in the production of manufacturers' wire. As an illustration, let us consider a material for cold heading purposes intended to produce a bolt of a given size and break strain, e.g. a 3/8" bolt with a break strain of 10,000#/sq. in. If we assume an un-heat-treated product and no analysis is specified we may then process in any manner we choose. One procedure would be to use a steel of about .10C + .45 Mn with normal P and S and draft the 3/8" wire from a 17/32" rod. A second procedure would be to use a 1035 steel of about .35C and .70 Mn and draft from a 13/32" rod. Since each of these conditions produces the physical properties required the question arises as to the quality of the material produced. In the first instance, the rod has been drawn 50% and in the second only approximately 15%. This immediately suggests the answer, since in the material that has been

Table A

Analysis				Temperature		
C.	Mn.	P	S	160°F.	170°F.	180°F.
.035	.15	.010	.028	1.09	2.50	3.85
.07	.25	.011	.034	3.30	4.50	10.70
.08	.45	.010	.029	4.5	8.0	12.6
.08	.36	.040	.035	19.70	24.0	33.0
.10	.37	.045	.041	21.40	30.8	40.2
.11	.39	.060	.031	17.85	37.8	53.0
.22	.57	.020	.035	21.0	20.6	33.0

reduced 50% its plasticity has been greatly reduced and replaced by cold work hardness, which causes the material to be extremely difficut to head and also produces a bolt which is brittle at the head and will probably break under slight impact. The other wire which is only reduced 15% maintains its plasticity, and produces a satisfactory product.

✦ ✦ ✦

Cold Heading Wire

LET us look for a moment at the practice of drafting of cold heading material. I believe that the general practice is a single draft of 1/32" for most material. Thus a ½" wire drawn from a 17/32" rod will be drafted 11.3%, whereas a ¼" wire drafted from a 9/32" rod will be drafted 21.0% and a ¾" wire from a 25/32" rod only 7.3%. This drafting on 1010 steel will result in tensile strengths of about 64,000#, 72,000# and 60,000# respectively, and from unnormalized 1035 steel of 98,400#, 108,000# and 93,500# respectively. Any of these materials will head properly under normal conditions but extreme upsetting would be difficult on the higher tensile materials, particularly on the 1035 steel in the unnormalized condition. Then as sizes decrease the material becomes increasingly harder because of the constant drafting, and hence for severe upsetting operations process annealing becomes necessary.

✦ ✦ ✦

Wire Finishes

NO discussion of wire mill operation today is complete without a discussion of wire finishes since this factor has become almost as important as chemical and physical properties. In approaching this subject we must realize that several factors enter into this problem both from the consumers standpoint and from the manufacturers standpoint. The finish the customer desires varies with the process through which the material passes during fabrication. Thus in the use of annealed wire for weaving operations, a wire which is perfectly smooth and free from scale or drawing lubricant is less satisfactory than one which is furnace or pot annealed, for when the wire is pressed into place in the loom it tends to spring back and with a smooth clean wire there is nothing to hold it, whereas a wire containing a slight scale coating will remain in position.

✦ ✦ ✦

Spot Welding Wire

COMPARABLE conditions apply in other uses, e.g. a wire for spot welding must be free of all lubricant so that perfect contact between the wires results. If lubricant is present in a uniformly continuous film uniform welding will result but high current is also required. If the wire is unevenly coated then a non-uniformity of welds results. Hence the preferable condition is a perfectly bright clean wire.

✦ ✦ ✦

Extruded Wire

CONVERSELY, wire to be extruded requires a uniform lubricating coating or the heat of extrusion and the pressure of the wire on the die face causes a pressure cementing which results in excessive die wear and galled or scratched wire. For a simple cold heading operation, with no extrusion, in an open or sectional die even a bright wire can be used. Again for wire such as nail wire where high speed cutting is required a definite type of coating must be used if clean cuts and long die life are expected.

✦ ✦ ✦

WITH these few brief illustrations let us look farther into the method of producing finishes, and of lubricating dies. I believe the most common practice of wire drawing today is to pickle the rod in sulphuric acid, rinse, dip in lime suspension, bake and draw with a proper die lubricant.

✦ ✦ ✦

Method of Producing Finishes—Pickling

SUPPOSE we consider each of these operations. The pickling operation is, of course, a necessity inasmuch as the scale must be removed prior to drawing. However, the pickling operation is an extremely important one and to a large measure influences the ultimate product. Accurate control of acid concentration, iron concentration and time is essential. If proper inhibition is maintained overpickling is difficult but from the standpoint of operation the time must be kept at a minimum. Also from the table previously presented an idea is gained of the metal loss resulting from long time in the acid. Thirty minutes in unhibited 6% acid at 180°F. shows variations in metal loss from .4% to 5.2%, which is immediately recognized as a tremendous loss in addition to the scale, which is a necessary loss.

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Liming

AFTER thorough rinsing to remove as much acid as possible the rods are limed, and here again is an operation of extreme importance. At the Wire Association meeting in October, 1937, **Mr. Washburn** presented a paper entitled **"Lime for Wire Drawing"** (Wire & Wire Products, Oct., 1937), which is a very good presentation of the differences in lime and its covering qualities. The function of the lime is twofold, first to neutralize the acid and prevent rusting of the rod and second to assist in the lubrication of the die. In the production of bright wire the former is the most important of the two purposes. In fact, were some method devised to remove properly the scale from the rod and bare the rod in a condition whereby it would not readily rust, a very good bright clean wire could be produced. However, in certain instances the second purpose is of extreme importance as it is upon this base that the finishes are produced.

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Baking

THE baking operation which follows is a moot question so far as necessity is concerned. At one time before the advent of inhibitors this was a very necessary operation as the amount of hydro-

gen enbrittlement was large. Today, however, with so many good inhibitors on the market and their almost universal use, baking is relegated to the background. However, to facilitate production and decrease the time between the pickle house and the drawing block baking becomes of value as the lime is quickly dried. This is also true in the production of bright finished wire as the rapid dry in the baker prevents any sulling action and ultimate stain on the wire.

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Drawing—Die Lubrication

LET us next consider the drawing operation and the lubrication of the die. The die itself will be eliminated from the discussion as it is a factor of its own. The advent of tungsten carbide dies has been a great aid to the wire producer, not because of the finish it produces, as these can all be produced in steel or cast iron dies, but because of the greater life and hence more accurate and uniform gages of product. Lubrication of a die may be stated in simple terms as the process of preventing metal to metal contact between the wire or rod and the die. In order to do this, some provision must be made to get the film forming material into the die. This is the point at which the lime first assists in the lubrication, because the amorphous coating readily carries with it the lubricant in the box.

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FROM this point several things may happen. If a soap is used as lubricant a reaction will take place with the lime forming a coating over the surface of the lime. The nature of this resultant coating is dependent upon the melting point of the soap and the amount of lime on the rod; as well as the speed at which the wire is drawn and the amount of draft. Whenever a rod is cold worked there is necessarily heat produced, and since the amount of heat is proportional to the amount of work the amount of draft directly affects the amount of heat. Also if a given amount of energy is expended in the drafting, and the major portion of this expended energy becomes heat and this operation is carried on at a high speed, then the amount of heat produced in unit time becomes greater and hence causes a different reaction in the die. The same condition exists in the use of a metallic soap, but the metallic oxide produced causes a very dry surface which goes to a fine powder under distortion, and hence is extremely satisfactory for upsetting and extrusion purposes. When it is desired to produce bright clean wire the amount of lime must be small and the lubricant of such nature that the film produced is exceedingly thin but of high elasticity, thus permitting as close a contact as possible between the metal surfaces to produce a polish, yet be sufficient to prevent pressure welding of the metals.

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Types of Lubricants

THE various compounds produced and used today for wire drawing purposes are too numerous to mention and all have their place. However, the lubricant that does a good job in one plant may be practically worthless in another since conditions of operation are all different. Therefore, production of finishes is each individual plant's problem and must be so considered. However, the basic principles involved are the same. The advent of the high speed continuous drawing machines has materially added to this problem of lubrication and has necessitated in many cases development of lubricants for each type of machine and grade of steel. This, of course, is in accordance with the foregoing considerations that draft and speed increase the temperature to a point where the surface tension of the lubricant fails. The use of water cooled dies and water and air cooled blocks materially aid in this matter and at the same time increase the life of the dies.

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The Function of A Wire Mill

THE foregoing discussion then presents a basis for consideration of the function of the wire mill. Of course, we say the function of the wire mill is to produce wire. This is indeed true, but its greater function is to produce wire that is satisfactory for the purpose for which it is intended. This means wire of definite specification, or what we may term "tailor made." The wire mill must, of course, process the rods delivered to it for a certain order, but it must also insure that the rods at its disposal are those that will ultimately produce the desired wire with a given method of processing. A steel rod of given size may produce either a satisfactory welding wire or a wire for manufacturing extruded bolts but the processing of each is entirely different as far as cleaning, liming, baking and drawing is concerned. Therefore the layout must consider these facts. However, if an order specifies grain size or a specific chemical analysis it must then either select or order rods for the purpose and subsequently process them for the desired results.

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YOU can thus see that the function of the wire mill is so varied that the task of satisfactorily producing wire requires extreme control and vigilance if uniform wire is always to be delivered. In addition, the wire mill must have complete cooperation of other equally well-controlled departments to complete the task.

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WIRE is only a manufactured form of steel, alterable either haphazardly or at will in every step of production from the ore. The production of good wire requires not only a thorough understanding of all operations, but the sympathetic cooperation of all manufacturing departments through whose hands the metal passes. And I am sure that any of my audience who work in other departments will join with me in saying that this spirit of teamwork is what must characterize any really successful steel plant, no matter what the character or shape of its output.

An Investigation of the Use of Back Pull in Wire Drawing

By Leon Simons,
Master Wire Die Corp., New York, N. Y.

DIGEST

WIRE is manufactured by being pulled through a hard-metal die onto a revolving drum from a reel which is slack. It is an ancient art, having a metamorphosis through the centuries by first being hammered into thin strips of tinsel, then being drawn through a die by hand and finally by being drawn by machine power.

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WIRE manufacture has been and still is an art because nothing is yet known of the actual stresses involved in drawing. Shop practice is handed down from father to son and consequently the manufacture of fine steel wires is held by relatively few people purely on the basis of their uncanny sense of the subject.

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THE rolling of sheet metal has been advanced to a much higher degree than has the drawing of wire. The Steckel rolling mill for example, has meant a great improvement in the method of rolling. In the Steckel mill, a tension is applied to the rear of the sheet as it is pulled through the rolls. The resulting benefit is a large reduction in the working pressure. Therefore, greater reductions are possible on each pass and consequently, less passes are required to roll metal down to a sheet of a given thickness. Another benefit of this process is the decreased wear on the rolls due to the reduced pressure on the rolls.

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THE purpose of this investigation is to demonstrate how these advantages can be obtained and how various physical properties of wire can be improved if a back tension is applied to the wire as it is drawn through a die. This investigation will also suggest a new method of determining what stresses are involved in wire drawing. ✦ ✦ ✦ ✦ ✦ ✦

Theory

IN ordinary wire drawing, the wire is drawn through a die onto a revolving drum which is slack. Let us imagine a section of the wire just before it approaches the die. If the previous cold work on the wire has been removed by annealing, we can visualize a grain in the center of the wire and grains at the periphery in an unstrained condition. As this section passes through the die, the grains on the outside of the wire are displaced backward so that the resulting orientation of the grains forms what may be termed a series of spherical caps radially parallel to one another and having a common center on the longitudinal axis of the die (see Figure 1).

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AN extreme of this condition is seen at the end of a drawn rod where it will be evident that the periphery of the wire has been displaced backward relative to the center of the rod. This effect is due to the shearing stresses set up by the compression on the cone of the die. These stresses result in rapid die wear at the point of impingement. "Cuppy" wire, having parabolic lesions at the center of the wire can be attributed to high shear stresses in many cases.

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IN a tensile test (see Figure 2) the opposite effect occurs at the region where the specimen "necks down." Here, the orientation of the grains takes a form that is just the reverse of that in the wire as it is ordinarily drawn. In order that the periphery of the specimen will form a parabolic concave surface, the grains on the outside of the wire must be displaced forward relative to grains at the center of the wire.

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THE method proposed is to combine these two effects by applying a tension at the slack end of the wire while it is drawn through the die (see Figure 3). However, the wire is not stressed to such an extent that necking down occurs as the purpose of this investigation will be unnecessarily complicated by a plastic flow outside of that produced by the die. It was predetermined that a load of 500 lbs. was the maximum back-pull to be used on the wires tested before the elastic limit was reached. Due to Poisson's ratio, the wire has a tendency to contract. Therefore the compression is correspondingly decreased and, as a result, the shearing stress is reduced. It is expected that a wire, with a much better orientation will result. If the grains will remain in the same plane or, at least, will not be unevenly deformed as they are in ordinary wire drawing, a more uniform and consequently a stronger grade of wire will be produced.

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Description of Tension Apparatus

IT was necessary to devise a mechanism whereby tensions could be applied to the wire from the rear as it was pulled through the die (see Figures 4a, 4b, 4c). In Figure 4a, the wire may be seen to pass over an idler pulley into the die. The pulley serves to align the wire entering the die so that it enters squarely. The rear of the wire is attached to a tray which cannot be seen in the views. Back pulls were varied by placing different weights in the tray. A pair of tongs integral with a screw may be seen to be pulling the wire through the die in Figure 4c. By rotating the handle on the worm and wheel unit, (Figure 4b) the

A thesis submitted in partial fulfillment of the requirements for the Bachelor of Science degree in Mechanical Engineering at the Massachusetts Institute of Technology 1936. This paper was awarded first prize.

screw and tongs are caused to move. In Figure 4a, the die is seen to be resting in a recess in a plate which has a three-point support. A piston serves as one support on the right hand side. The piston has a movement in a hydraulic cylinder which is hidden from view. The pressure in the cylinder registers on the pressure gage which may be seen. Dry soap was used as a lubricant but the soap box was removed to permit a view of the die.

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Procedure

IN these experiments, a .44C patented steel wire of .098″ diameter was used. All specimens were of the same bundle of wire and were drawn through a tungsten carbide die (14° angle, 50% length of bearing) down to wires of .080″ diameter, a reduction of area of 33⅓%. Back-pulls were varied from zero to 500 lbs. in 50 lb. steps. Pressures on the die were noted on the pressure gage. The pressure gage was carefully calibrated.

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DIE pressure readings with different back pulls show what can be expected of the wear of the die and the compression on the wire required for plastic flow of the metal. It was noted that the gage registered 400 lbs. compression on the die when there was no back-pull applied. (See Figure 5). As the back pulls were increased, the gage readings dropped so that when the maximum back pull of 500 lbs. was reached, the die pressure had dropped to 120 lbs. The force necessary to pull the wire through the die was calculated by adding the back-pull to the die pressure reading. The force necessary to pull the wire through the die represents the sum of the forces required to lift the weight and to deform the metal.

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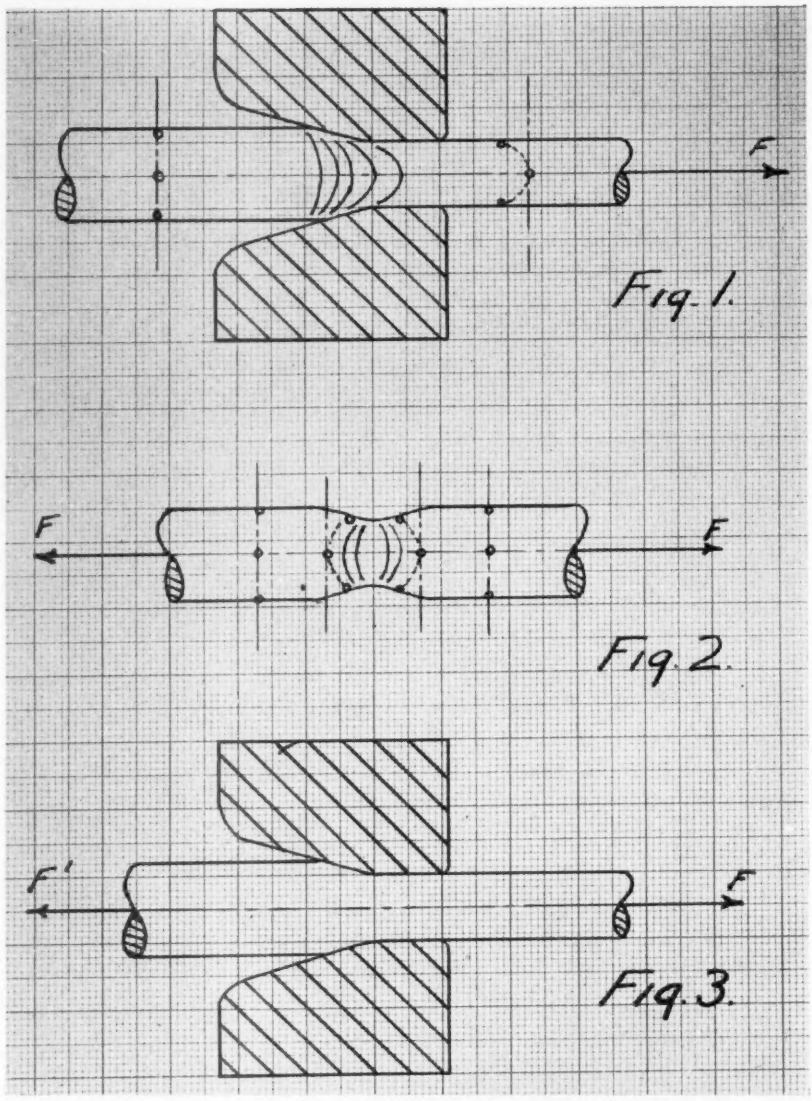
IT may be said that hardness is a function of the amount of cold work done on a metal. Therefore, it was decided that hardness tests be made of the cross-sections of each of the resulting wires. Since the diameter was only .080″, it would have been extremely difficult to take readings at various known points in the cross-sections. The solution was obtained by setting the specimens in bakelite casings for ease in handling. Then, by clamping the specimens to an angle plate on a machine shop surface grinder, the wires were ground off at an angle. Thus a much greater area was exposed with the consequent greater ease in getting hardness. It was necessary to grind the metal off very slowly in order to prevent the introduction of heat or cold work by



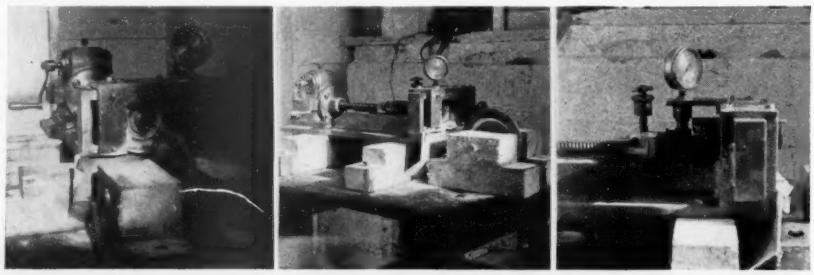


Fig. 4a. 4b. 4c.
Mechanism whereby tensions could be applied to the wire from the rear as it was pulled through the die.

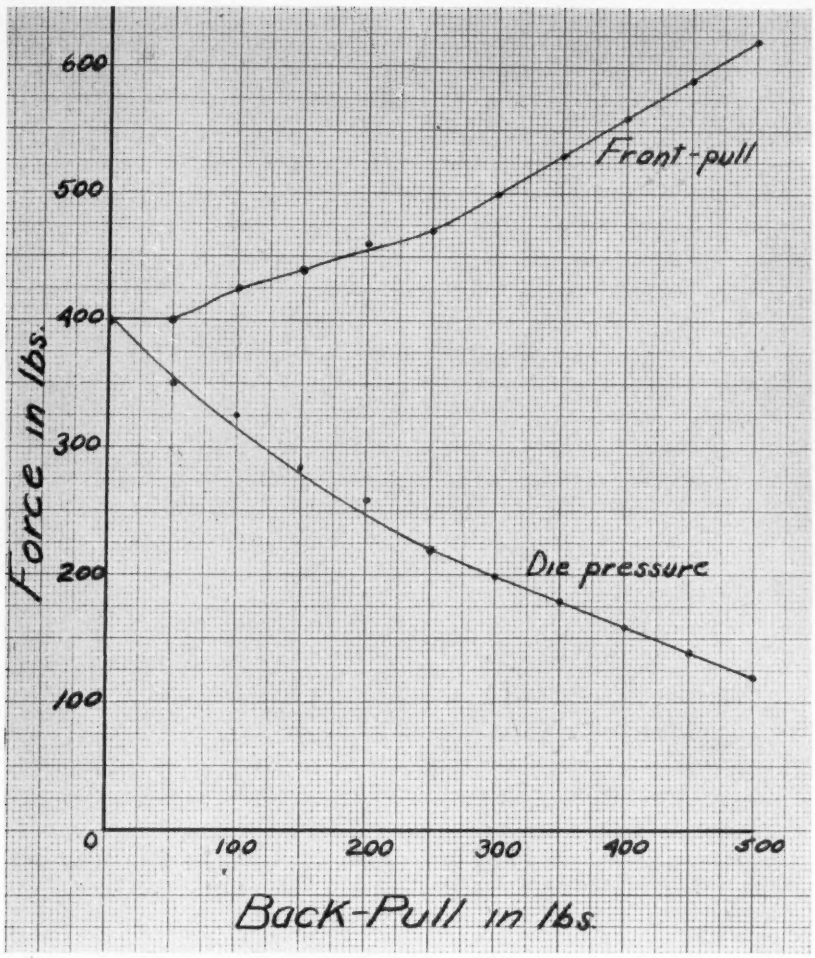
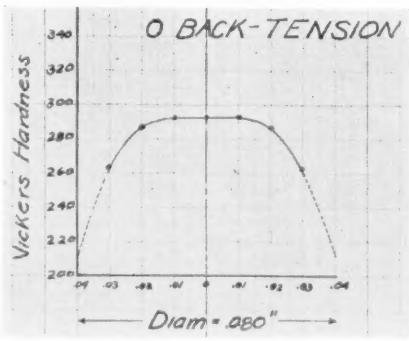


Fig. 5.

the action of the grinding wheel. In Figure 6 may be seen a picture of a specimen on which various regions have been marked off for testing. Hardness tests were taken on a Vickers Hardness Testing Machine with a load of 5 kilograms. A pyramidal diamond indentor and an objective of ⅔" was used. Readings were taken at the centers of the wires and at different points in the cross-sections with the aid of a cross-slide clamped to the table of the hardness machine. Plots of the hardness readings may be seen in Figure 7.



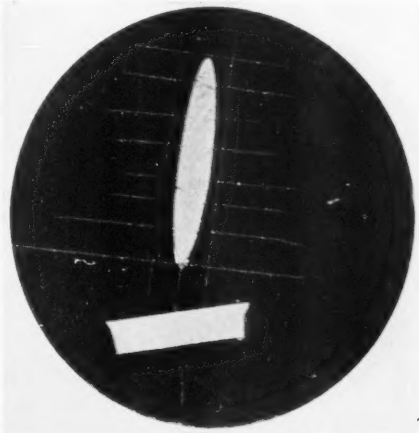


Fig. 6. Specimen on which various regions have been marked off for testing.

IT was thought that a check-up on the hardness readings at the centers of the wires would be helpful. "Pin-hole" X-rays were taken of the centers of the wires. The wires were prepared by very careful filing down in order to eliminate the possibility of cold work being introduced. The wires were filed to a thickness of .010" and exposed to the "pin-hole" X-rays for twenty hours. In Figures 8a, 8b, 8c, may be seen wires drawn with no back-pull, 100 lbs. back-pull, and 500 lbs. back-pull respectively. These pictures show by the degree of orientation the amount of cold work done on the center of the wire.

IN the future, pin-hole X-rays will be taken of these wires nearer the periphery in order to determine what effect the decrease in compression and shear had on

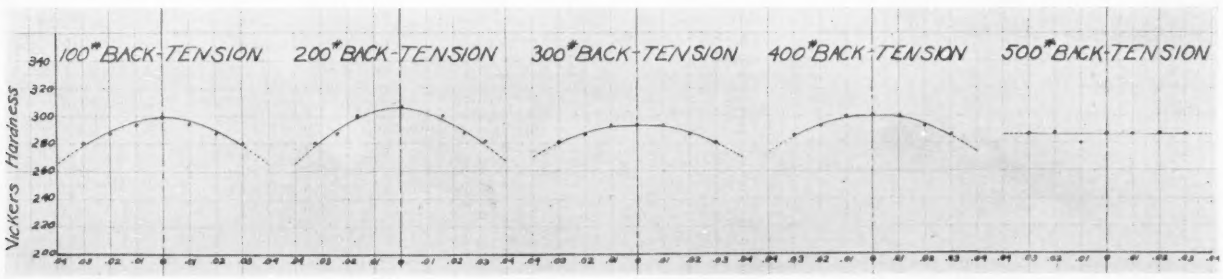


Fig. 7. Plots of Hardness readings.

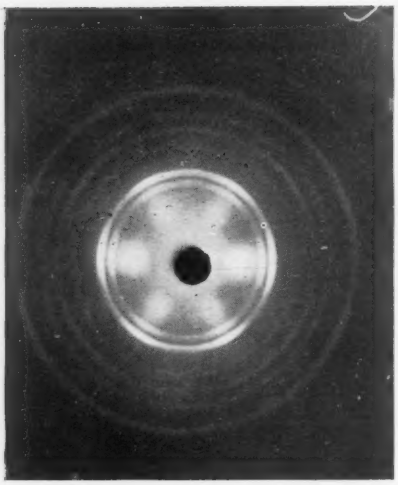
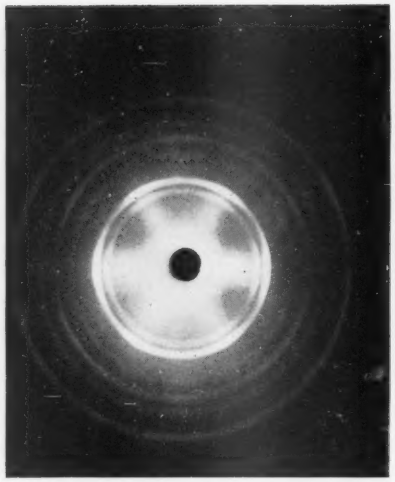
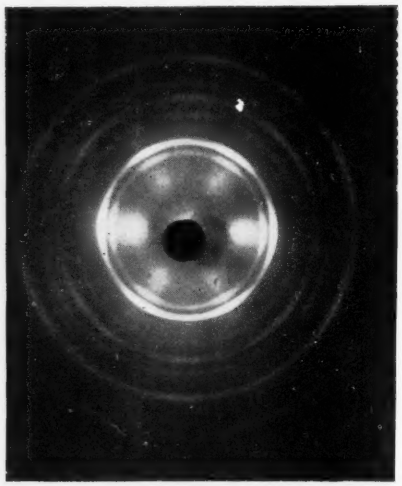


Fig. 8a.



8b.



8c.

Wires drawn with no back-pull, 100 lbs. back-pull, and 500 lbs. back-pull respectively.

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the amount of cold work in this region of the wire. It is proposed too, to determine if internal strains have been affected by the application of a back tension to the wire as it is being drawn.

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Discussion of Results

IF the plots for die pressures be examined, it will be easily seen that the reduction in pressure is very appreciable. The natural conclusion is that the die wear can be decreased; or with the same die pressure, a larger reduction can be made on a wire without danger of breakage of the die. As a result, the number of passes to produce a wire of any given size will be reduced.

THE necessary power for drawing is seen to increase with an increase of back-pull. However, the increase is not proportional to the additional load put on the wire. For example, if back-pull is increased by 50 lbs., the total force required for drawing is not 50 lbs. more but is increased by only 30 lbs. Evidently the friction has been reduced.

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DATA HARDNESS OF CROSS-SECTIONS

0 Back-Tension	
Distance from center in inches	Vickers Hardness
.03	262
.02	286
.01	292
.00	292
.01	292
.02	286
.03	262

300 lbs. Back-Tension	
Distance from center in inches	Vickers Hardness
.03	280
.02	287
.01	293
.00	293
.01	293
.02	287
.03	280

100 lbs. Back-Tension	
Distance from center in inches	Vickers Hardness
.03	280
.02	287
.01	293
.00	299
.01	293
.02	287
.03	280

400 lbs. Back-Tension	
Distance from center in inches	Vickers Hardness
.03	285
.02	293
.01	300
.00	300
.01	300
.02	293
.03	285

200 lbs. Back-Tension	
Distance from center in inches	Vickers Hardness
.03	280
.02	287
.01	300
.00	360
.01	300
.02	287
.03	280

500 lbs. Back-Tension	
Distance from center in inches	Vickers Hardness
.03	287
.02	287
.01	280
.00	287
.01	287
.02	287
.03	287

Die Pressure Readings	
Back-Tension in lbs.	Die Pressure in lbs.
0	400
50	350
100	325
150	285
200	270
250	260
300	220
350	200
400	160
450	140
500	120

Front Pull

Front pull=Back pull+Die Pressure
Example:
Front pull=400+160=560 lbs.

Back-Tension in lbs.	Front pull in lbs.
0	400
50	400
100	425
150	435
200	470
250	510
300	520
350	550
400	560
450	590
500	620

THE hardness readings are very significant and seem to open the door to a new knowledge of the flow of metal in the wire when it is drawn. By inspection of the hardness plots, it may be seen that the wire with no back-pull is harder in the center than it is on the outside. This great variation tapers off to the uniform hardness of the wire with maximum back-pull. And yet, with increased tension on the wire, the center of the wire with 500 lb. back-pull is no harder than that of the wire with no back pull. Evidently, back-pull causes no additional cold work on the center of the wire, but affects the peripheral region. It is safe to make this statement since hardness is a function of the amount of cold work done on a metal. The outside region has been hardened by a relief in compression while the center has not been affected by the increased tension.

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UNIFORMITY of the wire is especially beneficial in torsion and fatigue where the outermost fibres are most strained and should be at least as strong as the metal in the center of the wire.

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THE pin-hole X-rays show that there has been no change in orientation of grain between the wires with no back tension and those with. All specimens were cold-worked to the same degree as is evidenced by the same width and distinction of lines.

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IT is the writer's plan to continue this investigation in the near future to determine what effect back tension has upon residual stresses. It is believed that residual stresses will be decreased. One of the residual stresses in wire is a compression in the axial direction. With a tension in the rear, there is a possibility that the compression will be relieved.

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THIS new method of studying the flow of metal in wire drawing gives a different approach to the problem which has baffled many minds and it is hoped that further advances may be made in the technique of wire drawing through this study.

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Summary of Results

1. Back tension has been found to decrease the working pressure. Consequently greater reductions are possible in each draft resulting in a decreased number of drafts required to reduce a wire to any given size.

2. The drawing die life will be lengthened because of the reduced working pressure. Thus one of the important manufacturing costs of wire drawing will be cut.

3. Back tension makes the hardness more uniform through the cross-section of the wire.

4. Because of the more uniform condition of the wire, the wire has a possibility of better torsion and fatigue tests.

5. Most important of all, this investigation indicates a new method of qualitatively determining the stresses involved in wire drawing, when all equations for the evaluation of the stresses are admitted to be inaccurate.

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Suggestions for Future Investigations

WHILE this investigation indicates better working conditions and a more uniform wire, a further analysis of the problem will be of great aid in more definitely determining the advantages of back tension:

1. **That torsion and fatigue tests be made of wires produced with back-tensions.**
2. **That different die angles be experimented with when back tensions are applied and a best die angle be found for use in back-pull.**
3. **That complete tests be made to determine what the die life will be when back-tensions are applied.**
4. **That pin-hole X-rays be taken of the periphery of the wire and the cold work be more completely studied.**
5. **That an investigation be made of the residual stresses, if any, that are found in wire drawn with back-pull.**

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Summary of Pertinent Literature

VARIOUS authors have undertaken to express the stresses involved in wire drawing in mathematical terms. Up to the present time, none of the formulae have been of any practical use in the industry. I present these extracts with an explanation why the formulae fail to be of aid in calculations.

HORSBURGH (Transactions Institute Engineers and Shipbuilders in Scotland, 1931, Vol. LXXIV, p. 318): By making certain assumptions, a fairly simple mathematical relation can be set up between the total die pull F, diameters of entering and finishing, D_1 and D_0, and the half-angle α of the die. The assumptions are generally the following:

- (a) **That the pull in any given cross-section is uniformly distributed.**
- (b) **That the variation is tractive and compressive stresses in a longitudinal section is linear.**
- (c) **That a cross section plane before entering the die remains a plane section during its passage and after being drawn.**
- (d) **That flow at every point is the joint result of a tensile stress p and a compressive stress q and that their sum, p+q, increases uniformly from the point of entry to the point of exit of the wire.**
- (e) **That there is friction on the die walls determined by a coefficient of friction μ which is the same at all points.**

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UNDER these assumptions the equilibrium in a cross section of wire distant by the amount x from the exit can be written:

(1)

$$p\,\pi\,\frac{D^2}{4} = (p + \partial\, p)\,\frac{\pi}{4}\,(D + \partial\, D)^2 + q\,\pi\,(D + \tfrac{1}{2}\,\partial\, D)\,\frac{\sin\alpha}{\cos\alpha}\,\partial\, x + \mu\, q\,\pi\,(D + \partial\, D)\left(\frac{\sin\alpha}{\cos\alpha}\right)\partial\, x$$

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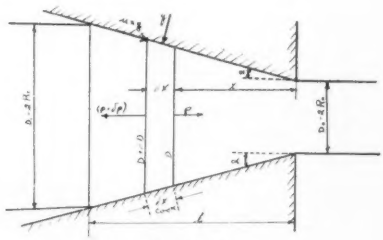

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EQUATION (1) can be simplified, by dropping infinitely small values of the second order and replacing D by $(D_0 + x \tan \alpha)$ to:

(2)

$$(x + \tfrac{1}{2}\,D_0 \cot\alpha)\,\frac{d\,p}{d\,x} + 2\,(p + q + \mu \cot\alpha\, q) = 0$$

(*Please turn to Page 260*)

The Manufacture of Steel Wire And Some Related Processes

By J. L. Schueler,
General Superintendent,
Continental Steel Corp., Kokomo, Ind.

PART II

Wire is demanded by the trade in so many sizes, analyses, tempers and finishes that its manufacture is probably the most complex in the steel industry. It is hoped that this brief article will afford some help to the buyer of wire in furnishing basic information of assistance in preparing specifications. ✦ ✦

Wire Drawing

WIRE drawing is an operation for reducing the cross-section and increasing the length of the rod by drawing it through dies, one die at a time, each die opening being smaller in diameter than the preceeding one.

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THE flow of metal in drawing is opposite in direction to that of rolling. The strain on the steel in drawing wire from one size to a smaller size must be less than the yield point of the steel. The yield point decreases at the temperature of the wire increases above, say 450 degrees Fahr. so wire is always drawn cold.

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WHEN drawing a wire to a given size, the wire is drawn through a tapered die hole, the exit, or bearing end of the hole, being the required wire size, due allowance being made for swelling, sucking down, and other peculiarities of drawing. As the hole in the die is smaller than the rod or wire being drawn, it is necessary to "point" the material so that it can be started through the hole.

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THIS is done by inserting the rod, or wire, between grooves in reciprocating rolls, or, into a swedging machine; the purpose of both being to reduce the diameter for a sufficient length so that the section can be threaded through the hole in the die and secured to the drawing block.

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Dies

DIES for drawing wire may be made of

1. Chilled Iron;

2. Steel;

3. Diamond, or some other precious stone, such as the ruby;

4. Cemented Tungsten carbide, or other hard metallic carbide, such as tantalum carbide.

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TYPES three and four above are used for the same purpose, that is, for drawing wire extremely close to gauge, except that, in the case of the carbide dies, large wire as well as small wire can be drawn. The use of precious stones is limited to the drawing of very fine wire.

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THE chilled iron dies are cast with a number of holes in them, usually two rows arranged in staggered relation. The contour of the holes embraces four distinct parts. On the entering side of the die the opening is tapered and larger in diameter than the wire or rod to be drawn and is, therefore, left as cast. The adjoining part of the die opening is finished to a definite taper. A considerable reduction in section of the rod takes place in this portion of the die, the taper being important, not only with regard to the reduction of the rod, but also to prevent breakage during the reduction. The next section of the die is called the bearing, and it is here that the wire takes its finished size. The exit end of the die is countersunk to prevent the edge from crumbling away.

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THE dies as manufactured, have holes sized for fine wire. After they have become worn the holes are opened up to a larger size, this being repeated until the die can no longer be used.

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WIRE drawing plates are a type of steel die. The treatment of plates is different from that of chilled iron dies. The holes in plates are originally formed and shaped in much the same manner as the chilled iron dies. When the holes become worn the plate is heated, the holes battered shut and then re-opened by means of suitable tools. The use of steel plates is limited at the present time in this country.

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CARBIDE dies are gradually replacing all other types of wire drawing dies. At the present time these dies are being used in general drawing practice. The carbide dies have made it possible to hold a wire within very close tolerance, and have made practical the continuous wire drawing machines finishing wire at high speeds. Except for their first cost, and mechanical defects inherent in the dies themselves, carbide dies have distinct advantages over any other kind of wire drawing die.

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Wire Drawing

WE have already described how a wire is pointed. This pointed portion of the wire is inserted by hand into the drawing die. The end of the wire is then

grasped by means of tongs or pullers, and pulled by mechanical power through the die, so that a piece is obtained long enough to fasten to the gripper of the drawing block. For very fine wire the pulling is done by hand.

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AFTER the wire has been so gripped, power is applied to the drawing block electrically, or mechanically by engaging a clutch mechanism. The block then rotates, the speed of rotation depending on the kind and size of the wire. As the block rotates, it pulls the wire through the die, thus reducing the wire section, and coiling the wire around the block. This operation is repeated, using smaller die openings until the desired size of wire is reached.

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FOR example 11 gage wire, drawn from a 5 gage rod, may require two or three drafts. The rod is first drawn to 8¾ gage and from this to 11 gage; or it may be drawn to 7½ gage, then to 9½ gage and, finally, to 11 gage. In the first case the wire would be called two-hole 11, and the latter case it would be called three-hole 11; the word hole, together with the number, designating the number of drafts necessary to make that particular wire.

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THERE are two types of wire drawing blocks, intermittent and continuous. With the intermittent type each intermediate size is drawn separately, whereas with the continuous type of machine, the wire passes continuously through the intermediates to the finished size. Mechanical means are arranged to take care of slack between each block in the continuous machines, because each smaller size of wire is longer than the preceding size.

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THE finer gages of wire are drawn from the smallest commercial size rod. Wire larger than 7 gage is usually drawn one hole from a suitable size of rod larger than the standard 5 gage rod.

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IF the rod is off-round then the large and small diameters get an unequal amount of cold work making the wire unsuitable for many purposes. Slivers in the rods pile up in the tapered entrance of the die and scratch the wire or cause the wire to break. Fins on the rods usually cause the wire to break as it is being drawn. Segregation and pipe cause internal ruptures of the wire during drawing, thus making the wire useless for products requiring special physical properties. Laps may cause breaks, large slivers or deep seams. Wire containing deep seams is not suitable for cold heading since the seams open up during the heading operation. Surface decarburization is most noticeable in the higher carbon wire used for cold heading, and is the cause of soft outer surfaces.

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Reduction Practice

WIRE is not always finished from the rod in one draft (one hole). Sometimes a number of holes are required because the wire does not have the strength to withstand single severe reductions without pulling apart (breaking). The practice for drawing wire to different gauges varies at different mills and depends to some extent on the type of equipment, the composition of the steel and the physical properties desired in the finished wire. Wire, of course, is not always round in section. Shaped wire is also manufactured. Shaped wire which may be square, oval, triangular, or other section, may be produced by rolling or drawing or by a combination of both processes. The measurement of the size of the wire is designated by decimals of an inch, common fractions, or gauge numbers, the latter being more or less of an emperical figure. The Steel Wire Gauge used in the U. S. is that formerly known as the Washburn and Moen gauge.

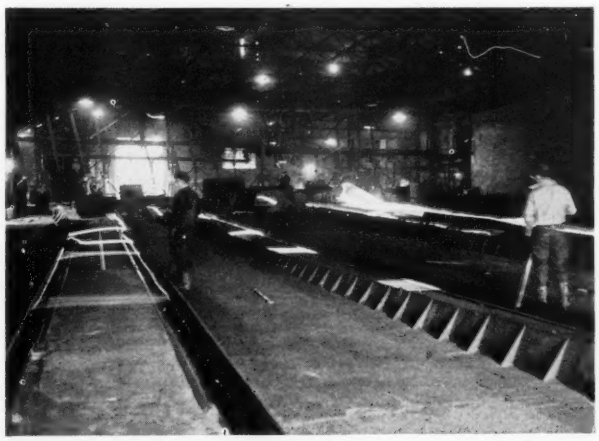

Fig. 6. Garrett Mill showing looping floor.

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Lubricants

THE question of suitable lubricants for wire drawing is highly important, grease, tallow, soap, oil, stearates, palmitates and other materials being used for dry drawing. In wet drawing there are two types of lubricants used, the cleaned rods or wire being kept wet by immersion in a solution which furnishes a suitable lubricant for the wire. In some cases this lubricant may be a light coating of copper or copper-tin depending on the finish required or it may be of the soluble oil type. Wet drawing is confined almost exclusively to fine wire except for certain types of wire which require an exceptionally clean surface finish.

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Weight & Size of Coils

UNLESS otherwise specified wire is furnished in catchweight coils. Anything other than full coil catchweight is special. Wire may also be furnished in even weights and in such case may contain more than one piece.

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THE standard size of coils for coarse wire are those made on wire drawing blocks having a diameter of 12 inches or larger. Fine wire is usually drawn on blocks having a diameter of 8 inches. The use of the proper size block for the different gauges of wire is a

matter of necessity because if fine wire was drawn on the large diameter block it would twist into the form of a figure 8 when removed therefrom. The large gauge wires are, from a practical standpoint, too heavy to be uncoiled from small diameter coils. Wire 16 gauge or smaller is classified as fine wire when drawn on 8 inch blocks, and 20 gauge wire or larger is known as coarse wire when drawn on blocks 12 inches or larger in diameter.

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Heat Treated Wire

WIRE as it comes from the drawing block, due to the cold work to which it has been subjected, is comparatively hard. The more the amount of cold work, the more the hardness (stiffness) of the wire. Wire may be furnished, therefore, as

1. **Untreated**
2. **Annealed**
3. **Processed**
4. **Normalized**
5. **Patented**
6. **Spheroidized**

✦ ✦ ✦

Untreated

THIS grade of wire includes wire where only light drafts are taken from the rod to the finished product and generally only one hole. The carbon range on this material is low—usually below .20 per cent carbon. Untreated wire drawn several holes, is also furnished where a stiff wire of high tensile strength is required, when the lower carbon ranges are suitable. This wire is known as Bright Wire, or Bright Basic Wire.

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Annealed

"ANNEALING" means to soften. Annealing consists in heating the finished sized wire to a suitable temperature and allowing it to cool slowly. There are two types of annealing, one type being used for the removal of cold working strains, and the other being used for the true, or full, annealing in which the steel is heated to higher temperatures than for the first type.

FOR example, the hardness caused by drawing a 0.12 per cent carbon wire can be completely removed by heating the wire to temperatures varying from 900 degrees to 1200 degrees Fahr. but for a complete, or full, anneal, the wire must be heated somewhere in the range from 1607-1697 degrees Fahr. Space will not permit us to discuss the reasons for this, but it is based on the principle that the grain structure of drawn wire begins to reform at temperatures several hundred degrees below the upper critical point.

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WIRE is usually annealed by one of four methods:

A. Pot Annealing
B. Lead Annealing
C. Tube Annealing
D. Muffle Annealing

and any annealing process consists in:

a. Heating the steel
b. Holding at the annealing temperature for a suitable length of time.
c. Cooling from the annealing temperature.

These three steps are always followed regardless of the process used for annealing.

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Pot Annealing

THE wire, in coils, is placed in pots, a cover placed over the pots, and sealed from the air by means of sand or some other suitable lute. The pots and contents are heated to the annealing temperature for a suitable length of time and then allowed to cool. After cooling, the cover is removed and the wire taken out. This is the intermittent process of pot annealing.

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THE continuous type of pot annealing is somewhat similar. The wire, in coils is placed in pots standing on cars. The cover of the pot is sealed into place and the cars are then moved into the furnace. This movement is timed, being gradual and continuous, and, except for the loading and unloading of the pots, is usually automatic. Temperature control within the furnace may also be maintained automatically.

WIRE produced by this process is called pot annealed or black annealed wire.

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IF bright dry drawn wire is pot annealed in a substantially non-oxidizing atmosphere it is known as Lime Bright Annealed Wire.

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IF copper or liquor finished wire is pot annealed in a substantially non-oxidizing atmosphere it is known as Bright Annealed Wire.

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Lead Annealing

HERE, the wire is drawn through molten lead held at a suitable temperature, several strands parallel to each other being passed simultaneously through the molten lead. Wire is not lead annealed in coils, always in strands. Lead annealing is more costly than pot annealing and does not produce as soft a wire as does pot annealing. Lead annealing lends itself well to annealing preliminary to the continuous wire galvanizing process.

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Tube Annealing & Muffle Annealing

WIRE is heated, a single wire to a hot tube, (tube annealing), or, a number of wires in a large closed space (muffle annealing). Wire is always heated in strands when tube annealed but may be heated either in coils or strands when muffle annealed. There are also combination processes of these two methods and also of both with lead annealing.

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TUBE and muffle annealing for wire are not, as a rule, satisfactory, unless the furnace atmosphere is maintained substantially non-oxidizing.

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Processing

THIS consists in annealing the wire at some point in the se-

quence of drawing operations, and then drawing further to the finished gage. Wire may be produced in several degrees of hardness (or softness), designated as medium soft, soft, or dead soft. The degree of softness is controlled by the carbon content of the steel, the temperature to which the steel has been heated, and the amount of reduction in area of the wire by drawing following the heat treatment. This wire is also known as Bright Soft Wire, and Bright Soft Basic Wire, and is generally used for severe cold heading.

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Normalizing

THIS process is similar to annealing, except that the wire is heated to a slightly higher temperature than the full annealing temperature (just above the critical range) and then allowed to cool slowly. Normalizing gives a tougher structure, and larger grain size, much more suitable for cold work, such as drawing, or cold heading, than does annealed wire. Normalizing is more costly than annealing and is used principally on higher carbon rods (0.25-0.45 carbon) which are to be drawn into what is known as normalized wire used chiefly for cold-headed products. The term normalizing as used for wire does not have the same meaning as the same term applied to other steel products.

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Patenting

THIS process is carried out by heating rods in strands to a temperature well above the critical range, followed by a fairly rapid uniform cooling. Patenting is generally used for rods which are to be drawn into spring wire, rope wire and similar products.

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Spheroidizing

THIS process consists in subjecting the wire to a thorough heating in the temperature range slightly below the critical temperature, followed by a very slow cooling. This treatment may be carried out either on the finished wire or at some intermediate drawing stage. Spheroidizing is usually used for wire which is to undergo severe forming operations, followed by a heat treatment.

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Tempered Wire

THIS type of wire is a modification of one of the above strand heating processes—the difference being that the wire after heating is quenched in molten lead, or oil, held at suitable temperatures depending on the structure required.

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Finishes

Sull Coating

AFTER the scale has been removed from the rods in the cleaning department, they are washed thoroughly and then subjected to a fine water spray to produce a wet rust called "sull". There are several degrees of "sull" which vary from a light colored water coat to a very heavy brown colored coat. The sull coat is a lubricant carrier, and is indispensible on wire to be used for certain extruding operations.

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Bright Wire or Bright Basic Wire

THIS is a term used for hard drawn wire which has no special finish or temper, as was previously mentioned. It is the wire just as it comes from the drawing block and is not necessarily bright in color.

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Extra Bright Wire

THIS is a type of wire having a bright clean surface produced by special cleaning room practice and drawing lubricant control. It is used where a bright clean surface is desirable, such as for tinning, plating and similar process.

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Coppered Wire

THIS wire has a copper coated surface produced by wet drawing the wire from a copper salt solution.

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Liquor Finish

THIS wire is drawn from a solution of copper and tin salts. Usually liquor finished wire is a light brass color, although lighter or darker colors may be produced.

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COPPERED and liquor finished wire may be furnished in varying degrees of temper.

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AS a matter of fact, round steel wire, since it has a simple cylindrical form, would appear at first glance to involve no complicated factors in its production. Nevertheless, wire is demanded by the trade in so many sizes, analyses, tempers and finishes, that its manufacture is probably the most complex in the steel industry.

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SUCH being the case, the writer has tried to avoid lengthy explanations and descriptions of a highly technical nature, and has made no attempt to present an exhaustive treatise. It is hoped that this brief article will afford some enlightenment on the subject, particularly to the wire user.

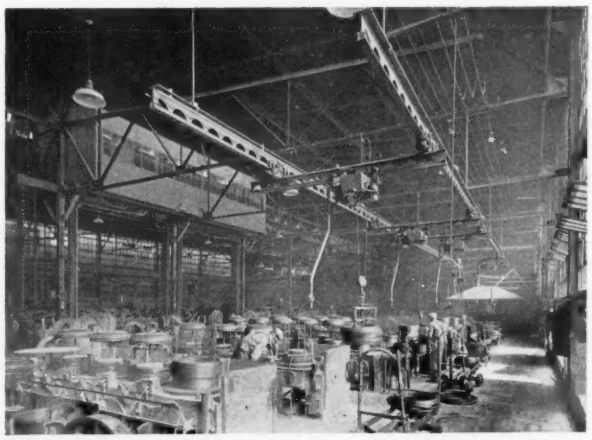

Fig. 7. Section of wire drawing department showing continuous wire drawing machines.

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Pittsburgh Regional Meeting of The Wire Association

By Richard E. Brown,
Editor, WIRE AND WIRE PRODUCTS, New York, N. Y.

MORE than 300 members and guests of the Wire Association attended the Pittsburgh Regional Meeting on April 1, 1938. No small part of the success of this Regional Wire Meeting was the extraordinarily well attended visitation to Pittsburgh Steel Company's Mills at Monessen, Penna. and Allenport, Penna. It was a beautiful clear, cool spring day. A registration table was set up in the lobby of the William Penn Hotel in Pittsburgh, and as rapidly as the visiting members and guests were registered they were grouped into parties of four and dispatched immediately to the mills in the many automobiles provided by Pittsburgh Steel Company. The driver of each automobile was an executive, superintendent or technician of the Company who acted as the individual guide for his party throughout the day.

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SOME visitors who came by automobile went directly to the Monessen Plant of Pittsburgh Steel Company where they also were met by a capable guide to conduct them through the plants. In the case of each of the small groups the guide was at their service to take them to whatever places in the mills in which they were most interested and to help them to spend the limited time to best advantage. Quite a number of the visitors were interested not only in some of the steel and wire making operations at the Monessen Plant, but also went to the nearby Allenport Works to see the Company's extensive manufacture of seamless steel pipe and tubing.

AT noon a delightful buffet luncheon was served to the visitors at the Monessen Armory, and the 236 luncheons served there represents the approximate total of guests with their guides visiting the mills that day.

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THE parties were all returned to Pittsburgh by about 6 o'clock, in ample time for the evening meeting.

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AT the technical sessions held at the William Penn Hotel in the evening, Mr. F. A. Westphal, President of the Wire Association and Superintendent of Wire Mills, Sheffield Steel Corp., was introduced by J. E. Timberlake of the Jones & Laughlin Steel Corp., chairman of the meeting. Mr. Westphal in his welcoming address stated:

"This is our Second Regional meeting of the Wire Association at Pittsburgh, and on behalf of the officers, directors and membership of the Wire Association I wish to express the fullest appreciation for the fine hospitality and courtesies shown more than two hundred of us today by the Pittsburgh Steel Company. It was most interesting and enjoyable to visit throughout their plant. Mr. Beeson, one of our newly elected directors, was the spearhead for this event, and we extend these sentiments also to Messrs. Sutherland, Vice President of Operation, and Carter, General Superintendent, and others of the personnel of Pittsburgh Steel Company for their fine attentions and efforts.

Mr. Timberlake of Jones & Laughlin Steel Corporation is our chairman of this Second Regional Pittsburgh meeting, and we thank him also for his efforts.

It is a pleasure to greet all of our members and guests this evening to hear and discuss the papers by Dr. Braley of Pittsburgh Steel and Mr. McCarthy of Wickwire Spencer Steel Corporation.

Like all established technical societies, obviously we are here to improve our professional knowledge, and to meet and fraternize with our associates in this Wire Industry. By the spirit personified today it reminds one of a real and sincere fraternity. This is a fraternity!

We must not lose sight of another important function of this Wire Association, and that is our method of professional assistance. Should any of us have a progressive problem or a perplexing problem, it means you may write the executive secretary your problem. In turn the executive secretary sends your questionnaire to certain qualified members, who in turn answer or solve the problem from their angle or experience and mail it back to headquarters. In turn the member gets the result and no identity of who presents the problem and who gives any answers are known or given whatsoever. This is a policy in case there are any doubts as to benefit derived from membership.

In closing I wish to remind you of our Annual Meeting at Detroit of the Wire Association to meet in conjunction with the National Metal Congress, October 17th-20th. Let us hope we shall all see one another there. We are working with our Program Committee under the Chairmanship of Mr. Seymour of Youngstown Sheet & Tube Company, and you may feel confident of an excellent schedule of papers in our technical sessions.

Best of luck to you all—I thank you."

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THE first paper presented was "The Function of a Wire Mill" by Dr. S. A. Braley, Industrial Fellow of the Pittsburgh Steel Company at the Mellon Institute of Industrial Research.

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THIS was a comprehensive review of various production practices in wire mills with emphasis on galvanizing, wire drawing, finishes, etc.

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THE second paper, "Factors that Influence Use of Metals" by B. L. McCarthy, Chief Metallurgist of the Wickwire Spencer Steel Co., Buffalo, N. Y., was presented to illustrate the idea that the constituent basic forms of metals may be

(*Please turn to Page 263*)

Outstanding Personalities of the Wire Industry

Frank J. Carr

FRANK J. Carr has been appointed Assistant to the President of the American Steel & Wire Co., subsidiary of the United States Steel Corp'n.

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MR. Carr for the past four years has been comptroller of the Tennessee Valley Authority at Knoxville, Tenn., and previous to that was comptroller of Aviation Corp'n. and subsidiaries after having held a similar position with Hahn Department Stores.

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MR. Carr is well known in accounting circles, having been one of the organizers and the first President of the Controllers' Institute of America. He is also a member of the Society for the Advancement of Management and the Cosmos Club of Washington, D. C.

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A NATIVE of Batavia, Ill., where he was born in 1892, Mr. Carr attended public schools there and in nearby Aurora, Ill., before going to the Wharton School of Finance at the University of Pennsylvania. He was graduated in 1915 with a degree of B.S. in Economics. During the World War he was a Lieutenant in the Ordnance Department of the U. S. Army.

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R. V. Isham

Heads Wire Sales at Sheffield Steel

SHEFFIELD Steel Corporation announces the appointment of Mr. R. V. Isham to the position of Manager Sales, Wire Division.

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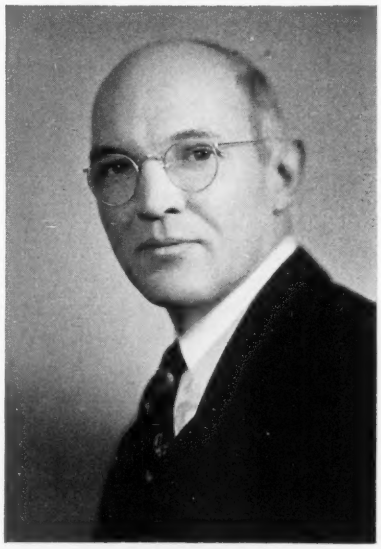
MR. Isham, familiarly known to his friends as "Ray", has been with Sheffield nearly 10 years. He became associated with this firm July 5, 1928, supervising dealer sales. Later his work included jobber sales supervision.



FRANK J. CARR
Assistant to the President,
American Steel & Wire Co.

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HE has had extensive experience in the sale of Sheffield's varied line of products and has a wide acquaintance in the steel consuming field, having travelled over almost the entire territory from Chicago to the west coast and from Canada to Mexico. His many friends will wish him a lot of well deserved success in his new position.

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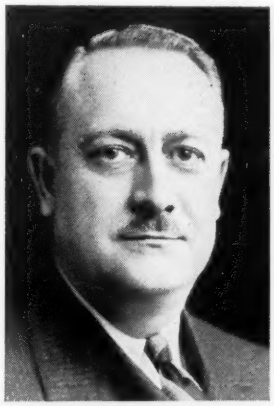

R. V. ISHAM
Manager, Wire Sales, Sheffield Steel Corp.

Powel Heads Westinghouse Industry Engineering

MR. C. A. Powel, recently appointed Manager, Industry Engineering Department, Westinghouse Electric and Manufacturing Company, with headquarters at East Pittsburgh, Pa., has been associated with the company since 1919, was born in 1884 in Rouen, France. His parents were Welsh and he was educated in England and Switzerland. Graduated from the Institute of Technology of Bern in 1905, he entered the application engineering department of Brown, Boveri & Company in Baden, Switzerland, the same year.

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SIX years later he was sent to Japan as resident engineer for that firm and remained there until 1915 when he returned to England and joined the civil branch of the Ordnance Department. Following the World War he moved to Pittsburgh and joined the Westinghouse Company. Previous to his recent appointment, Mr. Powel was Manager, Central Station Engineering Department.

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MR. Powel's participating activities of engineering societies have included a directorship and chairmanship of various committees of the American Institute of Electrical Engineers.

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Changes in Peter A. Frasse Company

PETER A. Frasse & Co., Inc., has announced the appointment of Mr. T. W. Hager as Vice-President, to act as assistant to the President, Mr. Lester Brion, in the general management of the company.

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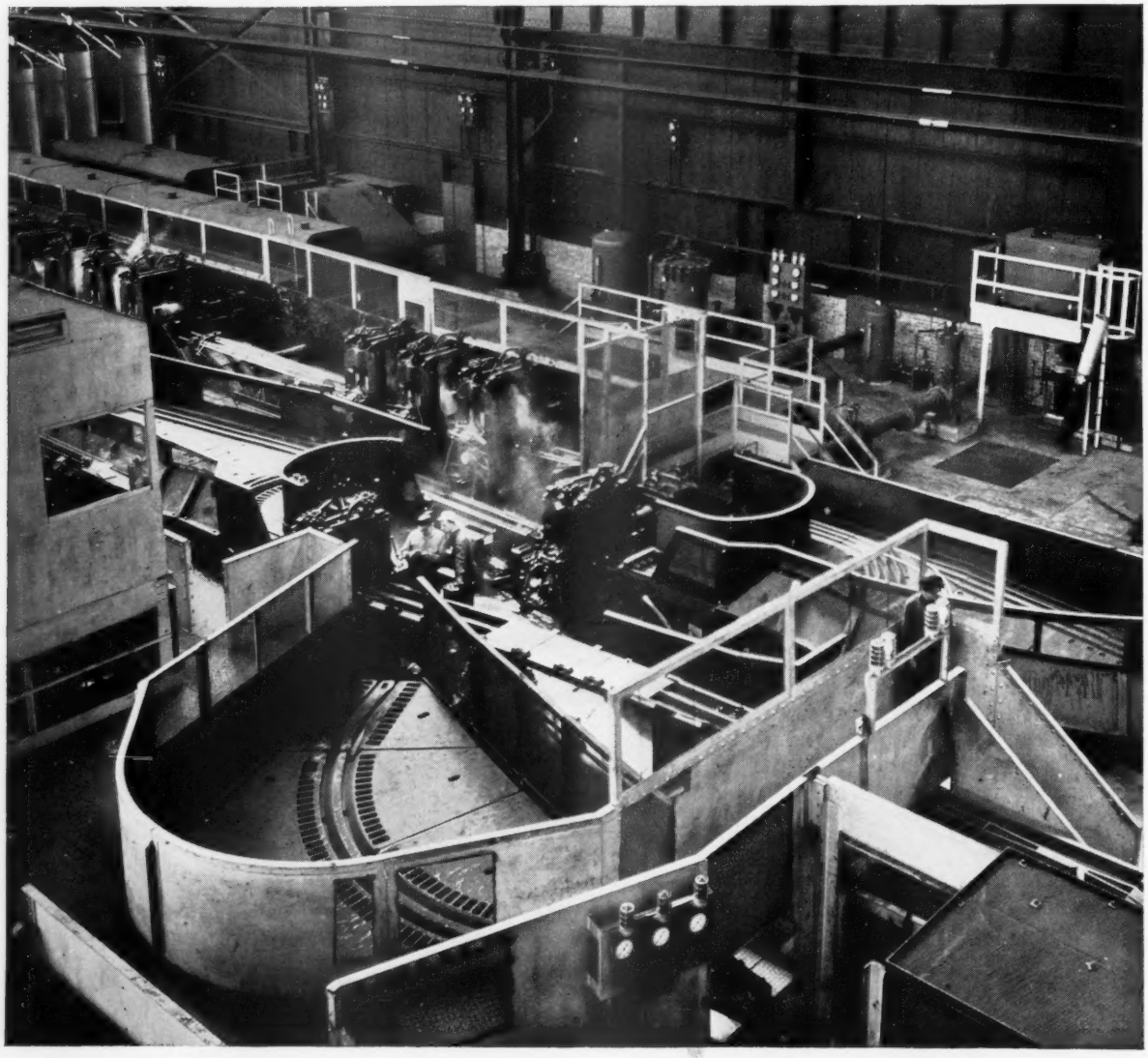
MR. A. B. Mead, formerly Vice-President and Manager of Philadelphia, has transferred his activities to New York, and will assume the duties of Vice-President and Manager of New York sales.

A new rod mill

broadens Bethlehem service to wire manufacturers



The opening of the new rod mill at the Maryland Plant has increased Bethlehem's rod capacity by more than 50 per cent. This addition to Bethlehem's modern facilities assures prompt and efficient service to wire products manufacturers on both large and small tonnages in a wide range of grades, sizes and coil weights.

Bethlehem makes a complete range of rods in three general classifications: basic-open-hearth and Bessemer in low- and medium-carbon ranges, and basic- and acid-open-hearth in higher carbon ranges. Rods in all analyses are made within these general classifications, providing material for wire for virtually every purpose.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

COLD WORKING OF METALS FINISHED PRODUCTS

Cold Worked Metals + + + Cold Formed or Machined Products + + + Cold Heading

1. Metallurgy and Research
2. Processes and Machinery of Production
3. Cold Heading
4. Cold Forming and Finishing Operations
5. Extruding

Vol. 13 MAY, 1938 No. 5

Visiting European Bolt Plants

By A. P. Newall, M.I.M.E.,
A. P. Newall & Company, Ltd.,
Glasgow, Scotland.

An interesting outline of various methods followed in bolt production in different European countries. + + + + +

MY hobby is visiting Plants and during 36 of my 57 years I have been all over the world; wherever in particular bolts were being made I have gone to see how things were done and I suppose in that time I have travelled nearly a million miles.

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IT might be interesting to your readers to hear a little of these travels and give a slant on how bolts have been made in Europe in the years just following the War.

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I REMEMBER my first experience of European travel, after the War was over, was brought about in rather a curious way. We had been making a large quantity of bolts for a French concern, who had a branch in England. They required these to have the thread right up to the shoulder and we were not able to satisfy their demands. They sent an engineer to Glasgow to discuss the matter and I told him that we just did not know how to do it, but he insisted that their works were doing it very successfully in France, though he could not tell me how. The result was that I decided to make a special visit to see how the operation was performed. When my wife heard I was going to Paris she immediately said she was coming along too. I had no idea when I set out just exactly where the works were situated, but I somehow had the impression that they were in close proximity to Paris. The morning after I arrived I rang through to the concierge to get me a car. I had always found it best in Paris to have a private car rather than to take taxis, so following my custom I decided to have a car for the day. When I got down and began discussing where I was going, the chauffeur announced that it would be a two days' journey, which rather took the wind out of my sails. However, having embarked on the adventure I thought it was best to see it through, so we started off. The main roads were so bad that the chauffeur said it was far better to stick to the secondary roads, which had not been cut up so badly.

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WE duly arrived and were received by the son of the engineer who had sent me over. It was a nice little country town and a nice quiet hotel. I very naturally invited the young man to join us for dinner and next day he came and took us down to the factory. Sure enough I found they were getting the thread right up to the shoulder, but they were employing a method which would never have occurred to me and indeed for this type of work I have never at any time in my travels seen used. They were utilizing a thread milling machine, which, of course, does the job perfectly but most definitely not economically.

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BEFORE leaving the hotel, I went as usual to the desk to pay my bill, but I was informed that I was the guest of the firm I had been visiting and there were no charges to be met. I was rather amused, however, when on my return I received a letter saying that while it was true I had been, with my wife, the guest of the concern I visited they hardley expected to pay also for anyone I had invited to dine with me and were enclosing a bill for so many Francs with a polite request that I should remit.

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NOT long after I had occasion to go to Switzerland and while I was staying at Zurich I was informed that there was a very interesting plant about 20 miles away, where they were drawing bars and making finished bolts and nuts.

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I WAS accompanied by our European representative, who, like all the Swiss, was a fluent linguist.

We arrived at a little country station and when we got out it looked the last place in the world to expect any kind of manufacturing plant, but the stationmaster assured us if we walked along the track for about a mile we undoubtedly would come to it and sure enough we did.

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ONE of the methods employed here was the system of decolletage, which has been common all over Europe for a good many years and is undoubtedly still being employed in certain factories. The decolletage method is to feed the bar up through a small Capstan type of machine and to push the cutting tools over the bar. To enable the worker to do the job satisfactorily, the milling, or turning operation as we call it, is done by means of a lever assisted by a belt which is round the operator's waist and also attached to the machine being operated. It looked like a very strenuous job, and considering that it was mostly being done by young girls, one felt that they were being rather badly used; however, it may not have been quite as strenuous as it appeared. The comparison of seeing men sitting at a bench examining the parts these girls were making seemed rather ridiculous. The appearance of the men in this factory was rather unique; they mostly had great flowing beards and moustaches and looked extraordinarily patriarchal; I do not suppose for a moment they were quite as old as they appeared.

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THE owner of the plant was a very interesting man and he was very ably assisted by his two sons. A particular feature of their occupation was that it was divided more or less equally between a farm, which was just across the way, and the bolt plant. This seemed to me then, as it seems to me now, a very ideal form of existence.

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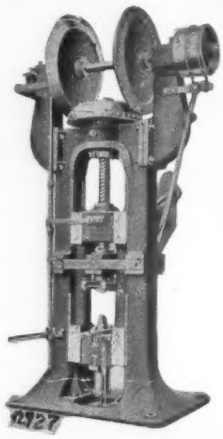
ANOTHER very interesting visit I made was to Italy. I was fortunate just at the time I was leaving to run into a man who evidently had connections there and he said he would be very happy to give me an introduction to the President of one of the large banks. When I arrived I presented myself to this gentleman and found him very helpful. I was somewhat surprised when he informed me that they had their own engineer on the premises and he would turn me over to him to give me what assistance he could. This



Vincent Press

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man seemed to be extraordinarily well informed as to everybody in the trades in which I was interested and he presented me with introductions to a great many people. I found these letters the Open Sesame wherever I went.

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AT the time of which I am writing, that is about twelve years ago, the Italian bolt industry was in very poor shape, though I understand it is now very much more advanced.

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THE current practice was to use the Vincent Press for forging, which indeed was a type of machine in common use all over Europe. This is a vertical machine operated with a screw driven from a friction wheel at the top and with the die rising towards the punch. Two serious drawbacks are that it is very apt to develop folds in the head, and also, owing to the fact that the die is solid, considerable taper has to be allowed to enable the bolt to be ejected. On the whole it works rapidly and for the commoner type of bolt is fairly productive.

TWO things that struck me were that every place had Landis Dieheads and that nearly everybody was using Poldi steel for dies. Indeed at that time all over Europe the Poldi people seemed to have the monopoly of die steel.

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AN interesting form of bolt manufacture which I have seen on the Continent is that employed for making Carriage Bolts. These are coned on a single blow cold header and the pieces are then put into a small gas type of revolving furnace and completed in a Vincent press. The boys who were employed on this work seemed to be very capable and got very large production. The bolt, of course, was very beautifully made and they got a fine large head and a well-shaped square.

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IN Germany of recent years there has been a very large development in the manufacture of cold-upsetting machines and there are quite a number of concerns engaged in their manufacture. They are in my opinion, however, not comparable with the similar type of machine made in the United States, largely I think because their experience of bolt manufacture had been concerned almost entirely with stock of very low Carbon and consequently much easier to fabricate. In the larger size cold-heading machines they employ a good deal more weight than the Americans, but it is not nearly so well distributed. There is no doubt, however, that of recent years a good deal of improvement has been made, but largely on the lines of following American practice.

✦ ✦ ✦

COLD-HEADING along modern lines is a comparatively recent development and heat-treatment has not reached the high standard to be found everywhere in the United States.

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CONVEYOR type furnaces are not yet in anything like general use, nor has the electric furnace with neutral atmosphere been extensively adopted. Owing to the relatively small demand for this type of bolt, the steel maker has

not yet approached the subject with anything like the interest of the large American concerns. There are, however, plenty of first-class engineers in the industry and it would seem only to be a question of time until they will catch up. There are, however, no comparable societies such as the American Society for Metals and the Wire Association, and, of course, as a consequence much less interchange of views among the people in the industry.

✦ ✦ ✦

Editors Note:

The business of A. P. Newall & Company, Limited was founded by A. P. Newall on September 29th, 1901.

It is a privately-owned concern and run by Mr. A. P. Newall, Mr. A. P. Newall Jr., and Mr. Charles Reid, Mr. Newall's son-in-law. Mr. Newall Jr. is Director and General Manager and Mr. Reid is Works Manager and Director.

During the War the business was run almost entirely on the manufacture of parts for aeroplanes, largely streamline wires and tierods and all the fittings that go with them.

The plant is practically entirely American and consists of a large number of National Acme and Gridley Machines, a battery of Brown & Sharpe No. 2 Machines, a battery of the National Acme "Modern" Nut Machines and Budd-Ranney Nut Machines. The Cold-heading Department is made up of Manville and Waterbury Farrel Plant and latterly the "National" Boltmakers. in 5/16", 3/8" and 1/2" sizes.

They draw their own bars and wire, and heat-treatment is carried out in electric conveyor furnaces built by the Birmingham Electric Furnaces Limited, Birmingham, who are in close collaboration with Electric Furnace Company, of Salem. These furnaces have now neutral gas atmosphere, ordinary town gas being used and broken up for the purpose. Carburising is done in boxes heated in electric furnaces and there are also a number of cyanide furnaces for surface work. There is a battery of Centreless Grinders and a great many Capstans of the Warner Swasey type.

Nuts are tapped very largely in the National Precision Tappers and are in sizes running from ¼" to ¾".

A very recent installation is the Morrison Flash Baker, which seems to hold great promise, especially for double extrusion work.

Practically all drawing is done through Tungsten Carbide Dies.

The buildings are of the saw teeth type and all on one floor.

Mr. Newall Jr. served part of his apprenticeship in the bolt-making department of the Ford Motor Company at Highland Park and Mr. Reid has also spent a considerable period in the United States.

Mr. Newall has been visiting America since 1915 at very frequent intervals and is well known to a great many of the members of the Association.

Societies to which Mr. Newall belongs:

Member of Institution of Mechanical Engineers, Iron & Steel Institute, West of Scotland Iron & Steel Institute, Institute of Metals, Institution of Engineers & Shipbuilders, British Standards Institution, American Society for Metals, The Wire Association.

Buffalo Bolt Company Installs Second Radiant Tube Annealing Cover

THE Buffalo Bolt Company of North Tonawanda, New York, recently installed a second radiant tube annealing cover for annealing, spheroidizing and normalizing rods and wire preparatory to cold heading. The first cover was placed in operation in February, 1936.

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IN operation, coils or rods or wire are stacked around a center spindle which is portable and has a flanged bottom. The loading is usually done with the spindle resting on the building floor. The loaded spindle is then moved on to a permanent base and thermocouples tied to the bottom, center and top of stacked coils as shown in Figure 2 on base #1. A light steel inner cover is then placed over the stack of coils, the lower edge of the cover resting in a self centering sand seal as shown on base #2. A radiant tube heating cover is then lowered over the entire assembly and also sealed in sand. Figure 2 shows heating cover #1 ready to lower over load on base #2 and cover #2 in position to base #3 ready for gas, air and electric connections. The double sand seal prevents infiltration of any air and oxidization does not take place to any noticeable degree with the annealed rod containing only the original mill scale. Even though controlled atmosphere gas is not used, no complete decarburization occurs.

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WHEN annealing wire, the slight amount of air entrapped in the inner cover is converted to a non-oxidizing atmosphere by the use of a wood block placed on the base with the charge, circulation being maintained by fans installed in the permanent base.

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WHEN annealing, spheroidizing or normalizing, after the work has been soaked at the predetermined temperature for the desired time, the heating cover is re-

(Please turn to Page 267)

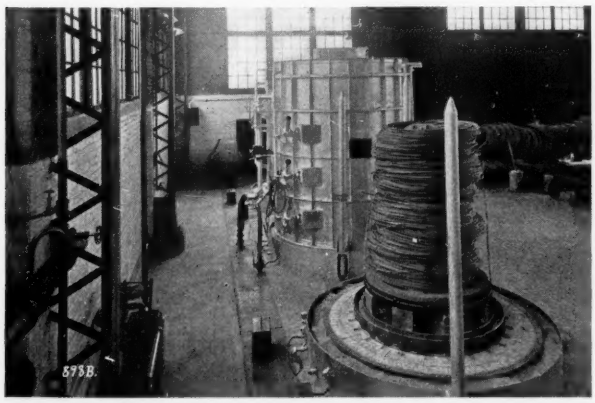


Fig. 1. Coils stacked on base ready for placing of inner cover. Note thermocouples and double sand seal. ✦ ✦ ✦

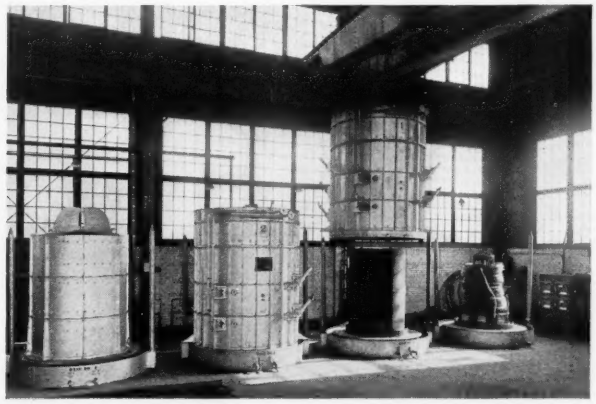
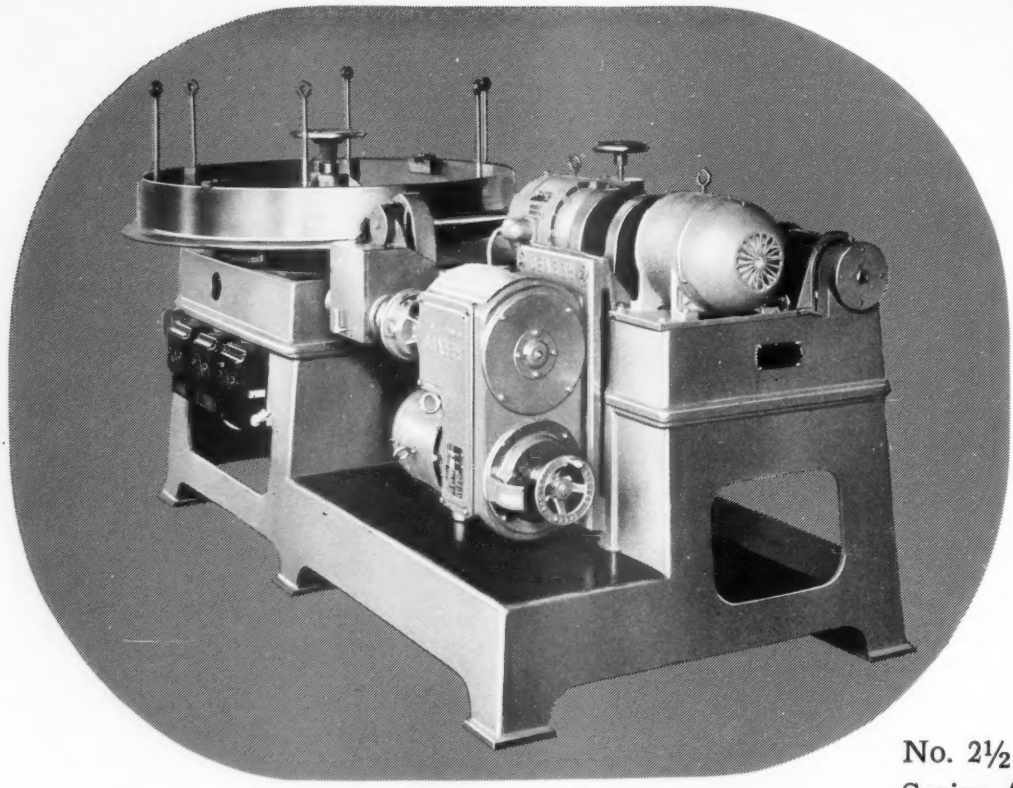


Fig. 2. General view showing sequence of operations. ✦ ✦



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Vol. 13 MAY, 1938 No. 5

The Effect of Longitudinal Scratches On Valve Spring Wire*

PART I

By F. P. Zimmerli, W. P. Wood and G. D. Wilson†

ABSTRACT

The object of this study was two-fold: the development of a method for the measurement of depths and contours of surface scratches upon spring wire, and secondly, to determine the effects of scratches with varying depths and contours upon the endurance limit in torsion of a typical steel spring wire. A special type of machine for carrying out torsional fatigue tests upon small sections of wire was designed and built. Scratches of controlled depth and contour were produced upon straight wire sections and their endurance limit in torsion compared with that of the same wire in unscratched condition. As would be expected, the presence of longitudinal scratches lowers the endurance limit of the wire to an appreciable extent. The decrease in endurance limit produced by the scratches was not, however, as great as the differences observed between polished and commercial wire when in the form of helical springs. The contours of the scratches were much more important than the depths of the scratches. Mechanical defects such as scratches produced during drawing and coiling operations can never be as serious in causing spring failures as seams produced in the wire during the manufacture of wire. ✦

THE presence of longitudinal scratches upon the surface of spring wire has always been troublesome to the manufacturers of helical springs. The cause, first considered, of all spring failures is a seam or scratch, yet all who have examined the metal adjacent to such failures are aware of how seldom the scratch or seam is present and how other reasons for the failure must be sought. The question is always in mind regarding the effects of depth and contour of surface scratches. Is there any limiting size or shape of scratch which may be considered relatively harmless as far as the performance of the spring is concerned since it is well known that springs do perform in a satisfactory manner with a certain amount of surface discontinuity? No inspection methods have seemed to furnish a satisfactory answer to this question.

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THERE are several causes to account for the presence of these scratches. They may appear during the processing at the wire mill, during the coiling operation, or may be the result of careless handling of the finished springs. The important thing, however, is not the original cause of the scratches, but what their potentialities are as a future source of trouble during the life of a spring.

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THE investigation reported in this paper was carried out with two aims in mind: First, the development of a method for accurately measuring the depths and contours of scratches, and secondly, to determine the effects of scratches with varying depths and contours upon the endurance limit in torsion of a typical steel spring wire. The investigation is in no wise considered as being complete, but is presented in the nature of a progress report with the thought that it may contain matters of interest and may stimulate helpful comment, since it is hoped that the study may be continued.

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Previous Investigations

A CONSIDERABLE amount of work has been done on the general subject of fatigue. The

*A paper presented at the Nineteenth Annual Convention of the American Society for Metals, Atlantic City, N. J., October 1937. Reprinted by permission of American Society for Metals.

†Of the authors, F. P. Zimmerli is Chief Engineer, Barnes-Gibson-Raymond Division of Associated Spring Corporation; William P. Wood is Professor of Metallurgical Engineering, University of Michigan; and G. D. Wilson is Metallurgist, Barnes-Gibson-Raymond Division of Associated Spring Corporation.

greater amount of attention has been given to bending—not so much to torsion. A study of the literature shows that little attention has been given to the effects of surface discontinuities upon the endurance limit in torsion. Many papers, of course, have been written which have a bearing directly or indirectly upon the subject. Space does not permit of a complete review of the literature. A selected bibliography is appended to this paper and, of course, some references from this list will be used during the discussion. In this bibliography, the first eight references are concerned with the development of the theory underlying the method used for calculating the stress at the bottom of a scratch on a bar which is subjected to torsional stress; the references from 9 to 13, inclusive, cover methods of measuring the depth and shape of scratches; and references 14 to 37, inclusive, cover the published work on the effect of surface discontinuities upon fatigue test results.

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Test Procedure

TORSION Fatigue Machine. A survey of the torsional fatigue machines on the market at the time of this investigation failed to locate one suitable for testing small wire specimens. Three torsional fatigue machines were therefore built after the design shown in Fig. 5. These machines are of the constant strain type. A movable jaw (a) oscillates through a rather small angle while the second jaw (B) is fixed. The test specimen is gripped securely by these two jaws. A connecting rod (D) is attached to a slotted rod (C) which is an integral part of the movable jaw (A). The other end of the connecting rod fits over a variable crank mechanism which is actuated by electric motor (X). The angle of twist is regulated by the double eccentric (U and V) so that stress values may be varied from 0 to a maximum or from a minus maximum to a plus maximum. All tests in this study were run from 0 to a maximum, since that is the manner of stress variation in helical springs. 1725 stress cycles per minute were applied, the total number of cycles being indicated by a counter (Y).

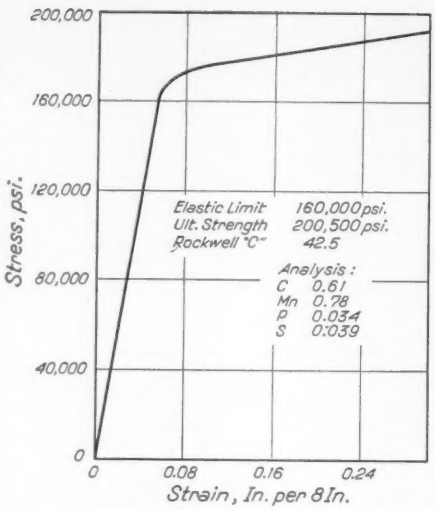

Fig. 1. Tensile Stress-Strain Curve. For 0.169 Inch Steel Wire Used in Fatigue Tests. ✦

✦ ✦ ✦

THE machine is stopped automatically when the test piece fails. A small current from a 6-volt battery passes through the test specimen as long as the specimen is unbroken. When the specimen fails, this current is interrupted and a relay is opened. This actuates an alternating current relay which cuts off the motor. The current through the test piece is about 0.15 ampere.

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Steel Used and Preparation of Specimens

THE steel chosen for this investigation was a high grade acid open-hearth valve spring wire. It was felt that such a material would be as nearly typical as anything. The chemical and physical properties of this wire are given in Figs. 1, 2, and 3. It is a tempered carbon steel wire produced in the United States and was taken from regular stock. Microscopical examination showed the wire to be free from seams and nonmetallic inclusions. The diameter was approximately 0.169 inch. Torsion tests were made on this material turned down to 0.110 inch, which was the diameter of the reduced part of the torsional fatigue test specimens. It will be noted from a comparison of Fig. 3 with Fig. 2 that there is no appreciable difference in the static torsional properties at this diameter and at the full diameter of the wire.

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FIG. 4 is an isometric drawing of the device used for making

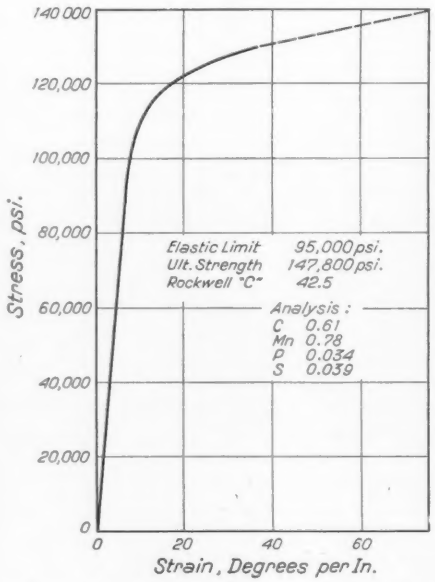

Fig. 2. Torsion Stress-Strain Curve for 0.169 Inch Steel Wire Used in Fatigue Tests. ✦ ✦

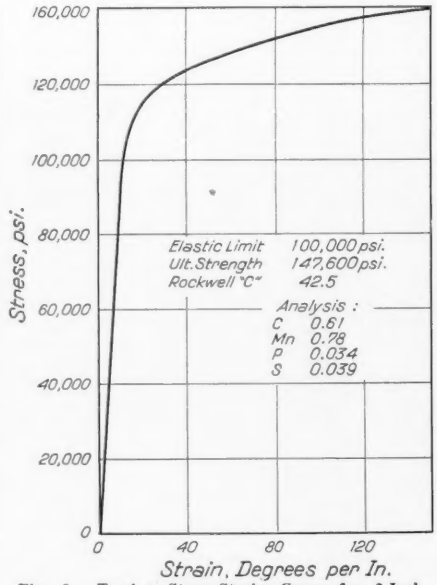

Fig. 3. Torsion Stress-Strain Curve for 2-Inch Section of 0.169 Inch Steel Wire Turned to 0.110 Inch Used in Fatigue Tests. ✦ ✦

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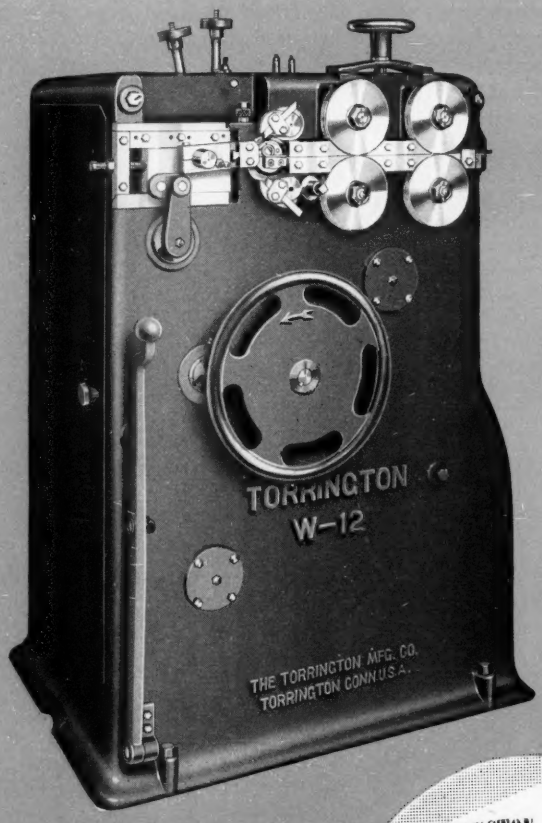

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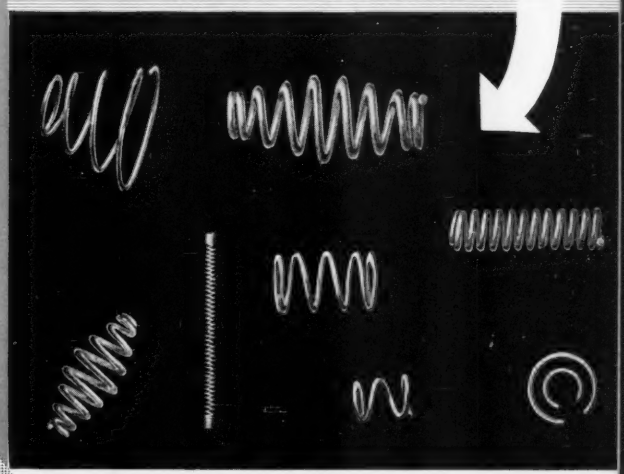

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scratches on test specimens. It consists of a holder for the tool and a device which holds the test specimen and moves it back and forth under the tool.

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THE tool holder (A) is hinged on a pin (B) and may be tilted back so that the tool can be easily removed for honing. The tool feed screw (D) is keyed to the tool by means of a key (E) and a slot (F) in the top of the tool. This enables the tool to be moved up and down with a positive action. The feed screw is graduated with 0.0005-inch divisions. These divisions are quite large so it is actually possible to move the tool up or down a distance of 0.00025 inch.

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THE device for holding the test specimen and moving it back and forth under the tool is essentially a moving stage (G) actuated by a screw and crank (H). The test specimen is held firmly on the stage in a direction parallel to the motion of the stage by two clamps (J). The clamps are so designed that the test specimen (K) is always centered under the point of the tool.

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FIG. 4 also includes a drawing of the test specimen as used in these tests. The reduced section is 0.110-inch diameter for a linear distance of 0.125 inch. The grip ends were ground to a square cross section about 0.134 inch on a side. All test specimens were ground in a lathe with 0, 00, and 000 emery paper. Finer paper was not used since H. F. Moore (21) shows no appreciable gain in endurance limit with the more highly polished test specimens. The diameters of the test specimens were carefully measured with pointed micrometers to within 0.0005 inch. The diameter used for calculating stresses was the diameter of the smallest part of the reduced section. If the specimen was slightly out of round, the smallest diameter was used.

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BEFORE starting a test run, it was necessary to determine the angle of twist required for the desired maximum stress. The specimen was inserted in the fatigue machine and clamped in the grips. The stress present in a cylindrical rod under a twisting moment is given by the expression

$$C = 16\,PR/d^3$$

where S = stress in outer fibres in pounds per square inch
P = load in pounds
R = length of lever arm in inches
d = diameter of the rod in inches.

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THE twisting moment required to produce any given stress in the test specimen could be calculated since the diameter of the specimen was known. When the angle of twist corresponding to a given stress was determined in the fatigue machine the twisting moment was produced by weights acting on the cable and pulley attached to the shaft of the fixed jaw. Knowing the radius of the pulley and the thickness of the cable, it is possible to calculate the lever arm through which the weights act. It is then possible to determine the weight necessary to produce the required stress in the specimen.

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THE angle of twist is measured by a system consisting of a mirror mounted on the fixed jaw shaft of the machine and a telescope and scale located a few feet from the mirror. The mirror was mounted on the shaft in such a manner that it rotated with the shaft about its axis. The rotation of the fixed jaw and shaft caused by a dead load on the cable produced a corresponding and equal rotation of the mirror. The load calculated for the given stress was suspended by the cable and a reading taken on the scale by means of the telescope which was provided with cross hairs. The load was then removed and another reading taken. The difference between these two readings gave a value of the angle of twist in centimeters on the scale. It was not essential that the angle be expressed in degrees or radians as it could be more conveniently expressed in centimeters on the circular scale. It was calculated that this method of measuring the angle of twist was accurate to about ±0.3 per cent. This corresponds to about 0.016 degree or 0.96 minute.

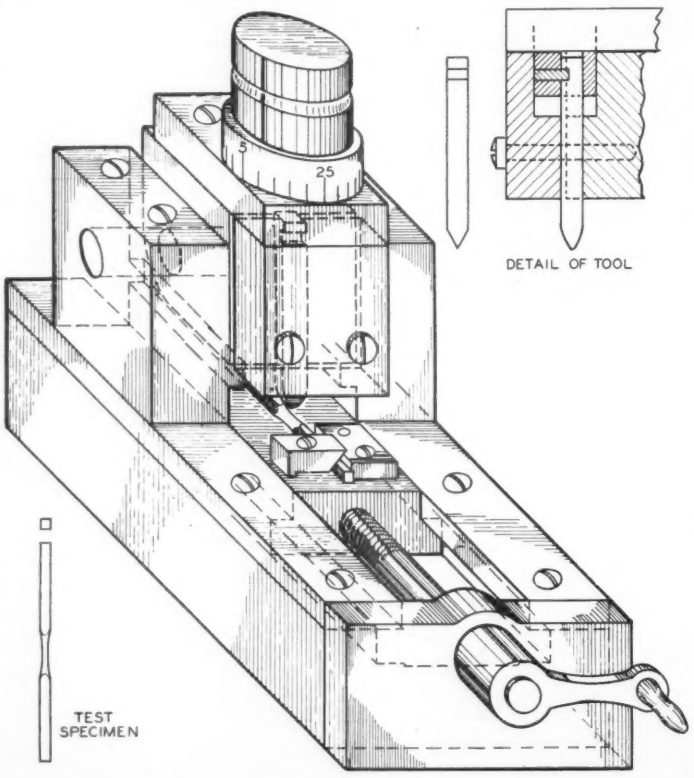

Fig. 4. Device for Making Controlled Scratches.

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LEAD plates were used for the loads to determine the angle of twist. These loads were measured on a Chatillon set of scales which were accurate

to about ±0.15 ounce or ±0.1 per cent. The two dead center positions of the crank of the fatigue machines were found by using an indicator on the movable jaw. The angle through which this jaw turns while the crank moves from one dead center position to the other must equal the angle of twist as previously determined to give the required stress. The angle of twist of the movable jaw was varied by changing the position of the small end of the connecting rod on the slotted rod (C) in Fig. 4. When this procedure did not give a sufficient range of adjustment, the relative positions of the two eccentrics (U) and (V) were changed.

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PRELIMINARY tests showed that the fatigue test specimens invariably suffered a permanent angular deformation or set shortly after the fatigue tests were started. This effect was also noted by Swan, Sutton and Douglas (34). The amount of the set was determined as follows: The crank of the machine was set at the position where no stress should be present in the test piece. The position of the fixed jaw was then read by means of the mirror, telescope and scale. The jaw was then unclamped, which allowed it to come to a position where no stress was present in the test piece, and a second reading taken. The difference between these two readings represented the amount of permanent angular deformation of the test piece. This behaviour of the test piece, of course, changed the stress cycle to which the specimen was supposed to be subjected. For example, if the original stress range was 0 to 100,000 pounds per square inch, after this permanent set had occurred the stress range might be found to be—15,000 to +85,000 pounds per square inch.

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AFTER some consideration, it was decided to compensate the effect of this permanent set by subjecting the sample to an initial twist (which produced an initial positive stress) before the fatigue test was started. This twist was found by trial to amount to from 5 to 25 per cent of the maximum twist used, varying directly with the size of the stress range. This initial twist was applied by dead loads and was measured in the same manner as the angle of twist corresponding to the stress range. Preliminary tests also showed that this permanent set took place during the first few hours of the test, the stress cycle remaining constant thereafter.

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THE machines were started and allowed to run for several hours after the initial twist had been applied to the test specimen. The machines were then stopped and the cranks set at the zero stress positions by means of the indicator previously described. Readings of the position of the fixed jaw before and after the clamp was loosened were obtained with the mirror and telescope. If the difference between the first and second readings was negative the test specimen had deformed more than was anticipated. In this case, an additional initial twist was applied to the test piece. If the difference between the two readings was positive, the deformation of the test piece was not as great as had been expected. If the two readings were identical, the deformation had been estimated correctly. In the last two cases, there was no need to apply additional twist to the test specimen, and the fixed jaw was therefore clamped at the zero stress position. This procedure

(*Please turn to Page 258*)

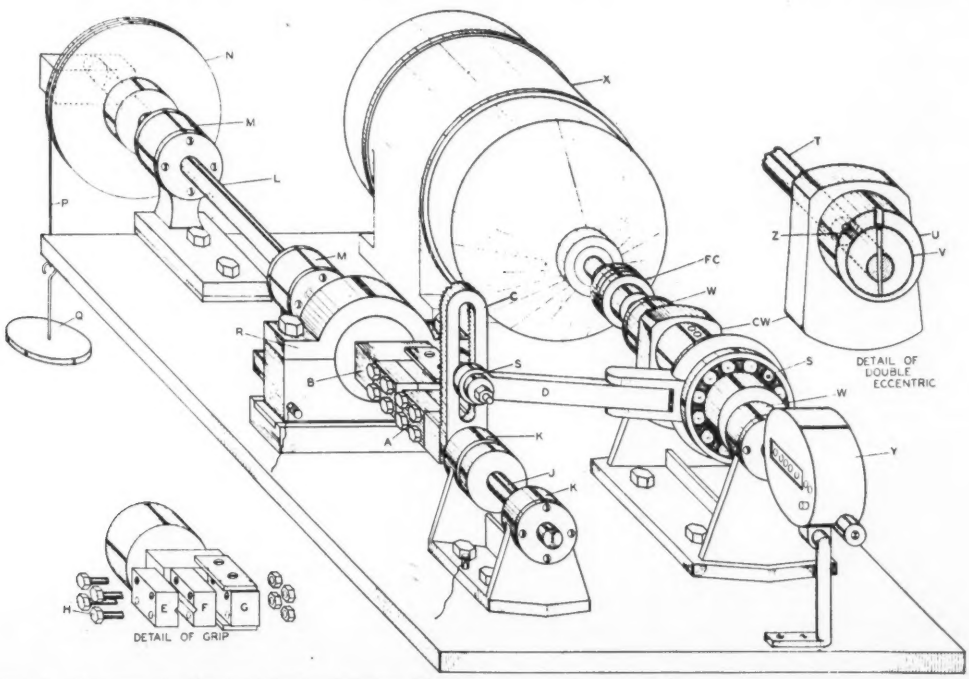

Fig. 5. Diagrammatic Sketch of Torsional Fatigue Machine.

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Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Feb. 1938 and Feb. 1937
(In Gross Tons)

	FEB. 1938	JAN. 1938	FEB. 1937
Wire rods	783	2,488	1,680
Strip steel	7,036	5,963	6,838
Plain, black or galvanized iron or steel wire	2,749	3,559	3,754
Barbed wire and woven wire fencing	1,052	965	2,956
Woven wire screen cloth	113	69	152
Wire rope	218	305	477
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	483	502	524
Wire nails	1,145	825	1,432
Tacks	16	10	33
Other nails, including staples	146	145	293
Bolts, machine screws, nuts, rivets and washers	616	700	895
Total, these 11 classifications	14,357	15,531	19,034

Imports of Iron and Steel Into the United States
(In Gross Tons)

Concrete reinforcement bars	263	45	98
Hollow bar and drill steel	103	125	199
Wire rods	588	504	974
Barbed wire	1,899	3,242	920
Round iron and steel wire	127	73	453
Wire rope and strand	165	213	197
Telephone and telegraph wire	2	.....	.....
Flat wire and strip steel	337	263	225
Other wire	111	259	279
Hoops and bands	1,263	2,177	2,407
Nails, tacks and staples	898	536	1,704
Bolts, nuts and rivets	9	12	91
Total, these 12 classifications	5,765	7,449	7,547

Exports of Insulated Wire and Cable, February, 1938

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Insulated iron or steel wire and cable	499,551	$130,877	158,981	$30,741
Rubber-covered wire	113,867	17,142	47,287	8,297
Other insulated copper wire	377,066	135,229	152,377	39,617
Nickel-chrome electric resistance wire	67,611	83,424	.....	.....
Total, these 4 classifications	1,058,095	$366,672	358,645	$78,655

Pig Iron, Steel Ingots, and Black Steel Sheets Heaviest Imports

SHIPMENTS of pig iron in February registered the highest volume with 54,332 tons in comparison with 35,997 tons in January, and 17,118 tons in February, 1937. The outstanding markets were Japan which took 27,107 tons; the United Kingdom, 21,673 tons; Canada, 3,603 tons; and the Union of South Africa, 1,339 tons. Next-ranking was steel ingots totaling 29,497 tons against 37,639 tons and 6,871 tons, going principally to Japan, 10,194 tons; the United Kingdom, 9,120 tons; Rumania, 6,732 tons; and Canada, 1,262 tons. Following came black steel sheets whose 19,986-ton total compared with 17,520 tons and 13,218 tons and was consigned chiefly to the United Kingdom, 4,312 tons; Canada, 3,247 tons; the Soviet Union, 2,352 tons; Mexico, 2,256 tons; Kwantung, 1,677 tons; and Australia, 1,583 tons, in a widespread trade.

✦ ✦ ✦

Tin Plate, Plate and Shape Exports Important

TIN plate was the fourth-ranking product in the month's trade from a tonnage stand-point (although the most valuable) in a world-wide trade aggregating 15,063 tons against 19,073 tons and 19,032 tons, the outstanding outlets being Brazil, 2,429 tons; Uruguay, 2,030 tons; Argentina, 1,734 tons; and British India, 1,118 tons. Plate followed with 13,339 tons against 27,453 tons and 14,890 tons and the most important amounts were taken by the Netherlands, 2,391 tons; Sweden, 1,475 tons; Canada, 1,399 tons; and the Union of South Africa, 1,521 tons. Shape shipments totaled 11,165 tons against 14,592 tons and 9,788 tons. The principal markets were Kwantung, 2,446 tons; Venezuela, 2,046 tons; and Canada, 1,404 tons. Steel bars came next with 10,493 tons against 18,917 tons and 7,216 tons and went chiefly to the United Kingdom, 1,352 tons; Kwantung, 1,189 tons; and Canada, 928 tons.

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Leading Export Markets In February

THE United Kingdom in February continued (for the fourth consecutive month) to be the outstanding individual market for American iron and steel products. A total of 40,130 tons of mostly pig iron (21,673 tons), ingots (9,120 tons), black steel sheets (4,312 tons), strip steel (2,099 tons), and steel bars (1,381 tons) was consigned to this outlet. Japan was next-ranking with 39,400 tons—the predominating products pig iron (27,107 tons), ingots (10,194 tons), and shapes (733 tons). Canada followed with 19,647 tons in a widespread trade in which the outstanding items were pig iron (3,603 tons), black steel sheets (3,247 tons), strip steel (2,409 tons), shapes (1,404 tons), plate (1,399 tons), and ingots 1,262 tons). Kwantung came next with 10,786 tons of mostly rails (3,875 tons), shapes (2,446 tons), black steel sheets (1,677 tons), steel bars (1,189 tons), and plate (1,083 tons). Next was Venezuela which took 8,290 tons of chiefly casing and oil-line pipe (3,114 tons), shapes (2,046 tons), and steel bars (572 tons). Sixth-ranking was Rumania whose 6,732-ton total was made up entirely of pig iron.

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Steel Pipe and Pig Iron Import Receipts Heaviest

STEEL pipe was the leading iron and steel product imported in February on the basis of weight, the 3,981-ton total comparing with 5,061 tons in January and 1,705 tons in February last year. Im-

ports came mostly from Belgium which furnished 2,298 tons, and Germany which furnished 1,174 tons. Next-ranking was pig iron with 3,354 tons against 9,747 tons and 11,340 tons with British India accounting for 2,842 tons of this total. Shapes followed with 2,072 tons against 3,147 tons and 6,762 tons of which Belgium furnished 1,741 tons and France 245 tons. Then came steel bars at a total of 1,666 tons against 1,899 tons and 3,578 tons, the chief suppliers being Belgium 1,291 tons, and Sweden, 292 tons. Following came hoops and bands with a 1,263-ton total against 2,196 tons and 2,756 tons, and in this case Belgium supplied 1,147 tons.

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Sharp Decline in Pig Iron Imports

PIG iron receipts in February recorded the sharpest decline of 6,393 tons when compared with the January trade. Other declines of moment occurred in the trade in barbed wire, 1,343 tons; steel pipe, 1,080 tons; shapes, 1,075 tons; and hoops and bands, 933 tons. The only increases of any consequence were those in sheets, 697 tons, and nails, tacks, and staples, 362 tons.

✦ ✦ ✦

Belgium Principal Origin

BELGIUM in February resumed its leading position in the supplying of iron and steel products to the United States, its trade aggregating 8,706 tons in comparison with 6,894 tons in the preceding month and 12,516 tons in February, 1937. The outstanding products received were steel pipe, 2,298 tons; shapes, 1,741 tons; steel bars, 1,291 tons; hoops and bands, 1,147 tons; barbed wire, 689 tons; and sheets, 633 tons. Following came Germany with 3,802 tons against 8,717 tons and 5,484 tons—the products outstanding being steel pipe, 1,174 tons; barbed wire, 1,110 tons; nails, tacks, and staples, 571 tons; and sheets, 476 tons. British India accounted for 2,842 tons against 5,491 tons and 5,863 tons with pig iron the only product received from this source. Sweden sent in 1,190 tons against 1,928 tons and 3,179 tons mostly of steel bars, 292 tons; flat wire and steel strips, 287 tons; and wire rods, 259 tons.

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CARD CLOTHING Receipts totaled 18,476 square feet valued at $33,234 against 23,422 square feet valued at $34,514, the principal supplying countries being the United Kingdom (16,489 square feet valued at $29,233), and Belgium (1,263 square feet valued at $2,503).

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WIRE HEDDLE receipts at 909,000 pieces compared with 1,053,000 pieces, and originated in Germany (407,000 pieces), Japan (402,000 pieces), and Switzerland (100,000 pieces).

✦ ✦ ✦

THERE was no trade in the galvanized before weaving grade of WIRE FENCING AND NETTING, against 907,000 square feet in January. Of the galvanized after weaving, the total was 782,-

(*Please turn to Page 268*)

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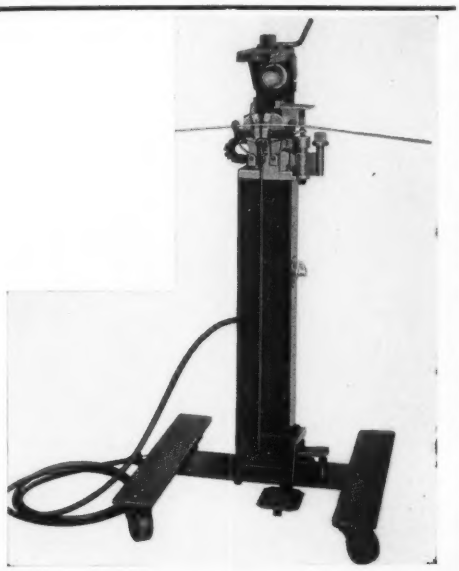

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Telephone State 7468

'Round the World With the Wire Industry

German Notes

REPORTS that the IWECO would soon start negotiations with the Canadian wire industry in regard to competition on the British and other Continental markets have not been confirmed. Canada is competing chiefly with wire nails, but in all other wire products competition is negligible.

✦ ✦ ✦

German Wire Prices

PRICES for wire products are unaltered with the exception of certain markets in the Near and Far East. The wire rod price at present is £ (gold) 6.2.6 officially, but the majority of all markets are able to buy wire rods at £ 5.12.6 to 5.15.0. Japan is buying at 5.10. Firm bids for wire rods are very frequent but the international wire rod cartel reports that prices are not touching and that most of the firm bids had to be turned down. The demand for S. M. wire rods is very small at present and shows a tendency to further decline. Wire rods, medium hard, are in good demand in European markets; hard, however, particularly with over 1% content, is neglected.

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Continental Wire Industry

THE European wire industry has less orders in hand and this has materially influenced operations. At undiminished speed and with apparently no decline in unfilled orders, Germany's wire industry is still operating at 92 to 94% capacity; the wire industry in January and February almost reached full capacity. Poland's wire industry, which was down at 50 to 60% in the summer of 1937, has improved operations to over 80%. The Belgian industry has slowed down to 48 to 52% after working over 90% in the summer of 1937. The French industry is operating at present at 68 to 70% after operating at 78 to 80% six months ago. The Swedish industry was operating at 90 to 92% in the summer of 1937 and at present is at 77 to 80%. A similar decline is reported by the Danish industry. Czechoslovakian industry reports a fall from 87 to 89% in the summer of 1937 to 70 to 72%, and the Austrian industry from 82 to 84% to 67 to 69%, while the Hungarian industry is still operating at full capacity. Switzerland's industry declined from 80 to 82% to 65 to 67%, whereas the Italian industry is working at more than 90%. The Balkan industries are working at about the same pace as last year.

✦ ✦ ✦

German Wire Machines

IN wire machinery the trade continues to be very lively. Many orders have come to the German wire industry from the Leipzig

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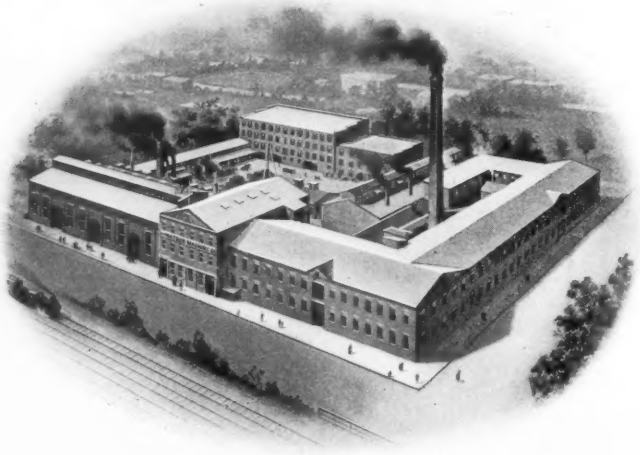

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spring fair. The average shipment dates are five months for the filling of new orders. The situation is the same for machines for making bolts and nuts, whereas screw machinery is in less demand. The makers of cable and wire strand machines have large orders on hand.

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German Exports

THE German exports of nonferrous metal wires in 1937 showed an increase in aluminum, zinc and lead, and a decline in copper from 5,046 tons in 1936 to 4,913 tons in 1937. Exports of brass wire went up from 6,453 tons to 6,620 tons, whereas the exports of copper strand wire declined from 2,191 tons to 1,813 tons.

✦ ✦ ✦

NEGOTIATIONS have been completed with the Czechoslovakian wire industry concerning prices and shipment conditions for higher quality steel wire for industrial purposes. In the future the Czechoslovakian steel wire industry will cooperate with the German and the Belgian industries.

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General Notes

THE Bureau of Foreign and Domestic Commerce of the Department of Commerce supplies the following information:

✦ ✦ ✦

Japanese Policy of Restricting Hoop and Band Imports

IT is understood locally that the **Japanese** Government is following a policy of restricting imports of hoops and bands to sizes not produced in Japan, advises the office of the American Commercial Attache, Tokyo. However, the Hoop Iron Sales Guild is stated to be petitioning the Government for permits to import hoops of 200 to 300 mm. size on the grounds that these sizes are not now produced in Japan and are badly needed in the making of large tubes for shipbuilding.

Boom Conditions at Port Kembla

OWING to the expansion of **Australian** iron and steel production, combined with the construction of an American branch factory, and the new coke ovens which have been placed in operation, boom conditions are reported to prevail at Port Kembla, according to a radiogram from the office of the American Trade Commissioner, Sydney. The total production of steel ingots in Australia during 1937 is reported at 1,200,000 tons, in comparison with 881,000 tons in 1936. It is stated that for the first time in several years, local manufacturers increased their "steel prices" in a range from 5 shillings to 20 shillings per ton, but it is stated further that this increase was apparently not sufficient to materially affect the local demand.

United Kingdom to Restore Former Import Duty on Iron And Steel

EFFECTIVE April 1, 1938, the **United Kingdom** restored the former import duty rates on iron and steel products, according to an announcement made by the local Import Duty Advisory Committee, advises the office of the American Commercial Attache, London, by radiogram. These duties were temporarily reduced last year until March 31, 1938.

✦ ✦ ✦

Nail Production in Philippines

SINCE December, 1937, the **Philippine Island** Mining Machinery and Electrical Supply Company, Inc., has been producing, among other things, nails, bolts, and nuts of various sizes, advised the office of the American Trade Commissioner at Manila. The

(Please turn to Page 254)

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'Round the World With the Wire Industry

(*Continued from Page 253*)

daily output of "common wire nails of various sizes" is estimated to be between 7 and 8 metric tons daily. Up and until about the middle of January of this year the firm in question had produced approximately 500 tons. It has also produced about 100 tons of machine screw bolts and nuts. Nails are sold principally at wholesale, prices varying from 6.80 pesos to 8.40 pesos per box of 60 kilograms. Dealers are allowed special discounts. In the case of standard one-inch nails, the dealers' price is 8.55 pesos per box of 45 kilograms of 100 pounds net. Other consumers pay 8.75 pesos. The same rates of discount are allowed to dealers on bolts and nuts.

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THE Bureau of Foreign and Domestic Commerce of the Department of Commerce in a recent report states that Argentina in February imported 2,634 tons of wire from the United States among other steel products. The Department further reports that in Cuba there was keen competition in wire products and that the domestic nail factory continued to obtain an increasing share of the business.

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IT was stated that the principal iron and steel items imported by New Zealand from the United States in 1937 were plain fencing wire and hoop iron. These items, should of course, be of interest to American wire producers.

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IN connection with the information on New Zealand it is stated that the New Zealand government has announced its intention to erect a plant for the manufacture of steel sheets, bars, wire products, etc., and it is estimated that the full production of approximately 100,000 tons of semifinished steel products will be attained at the end of two years.

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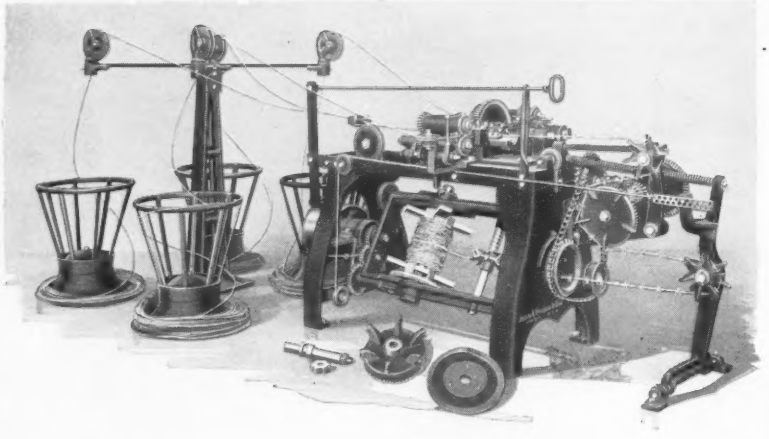
AN investigation is now under way in South Africa to determine whether or not it is feasible to produce more steel in the South African Union. If it is decided to take any action along this line the higher production would be effected by "Iscor" and the African Metals Corporation, — recently formed with $500,000 capital to develop the base metal resources of the South African Union.

✦ ✦ ✦

Stainless Steel for Treating Banknote Paper

A process for treating banknote paper is reported to have been developed in Zurich, Switzerland whereby it is claimed that the life of the paper is considerably lengthened and is also given a higher protection against counterfeiting and destruction by fire, advises the American Consulate General at Zurich. Molten steel under high pressure is sprayed against the paper, impregnating its fibres with fine particles of metal, it is stated. The inventor of this process claims that the deposit of metal on the paper neither increases its weight perceptibly nor diminishes its flexibility. No further information is available at this time.

Glader Barbed Wire Machine



The GLADER Barb Wire machine is used throughout the world for the production of Barb Wire of any type or style of 2-point or 4-point wire, made from round wire.

The machines are furnished to make 2-point or 4-point wire, and with the necessary extra parts, can be arranged to make both 2-point and 4-point wire on the one machine.

The GLADER machine is very compact in construction and the main chain of gearing that drives the barb coiling mechanism is of cast-steel with machine cut teeth.

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A Review of Recent Wire Patents

No. 2,109,282, SPRING STRUCTURE FOR FURNITURE AND THE LIKE, Patented February 22, 1938 by Samuel S. Bernstein, Beverly Hills, Calif.

Within a frame a plurality of rows of springs is supported by a fabric secured to the lower face of the frame, and provided with upwardly extending spaced flaps through which coils at the lower ends of the springs extend, for anchoring purposes, the upper ends of the springs being tied.

✦ ✦ ✦

No. 2,109,334, COMMUNICATION CABLE COMPRISING ONE OR MORE SCREENED CORE GROUPS, Patented February 22, 1938 by Heinrich Kaden, Berlin-Siemensstadt, Paul Thomas, Berlin-Wilmersdorf, and Hans Wassmansdorff, Berlin-Spandau, Germany, assignors to Siemens & Halske, Aktiengesellschaft, Siemensstadt, near Berlin, Germany, a corporation of Germany.

As a means for reducing cross-talk in long distance communication cables having a group of cores twisted about a common axis, a screen is provided which consists of a plurality of good conducting strand elements laid side by side helically around the group and having the same twist direction and pitch as the core twist.

✦ ✦ ✦

No. 2,109,697, SEATING FURNITURE CONSTRUCTION, Patented March 1, 1938 by Darwin Hanauer, La Grange, Ill., assignor to Nachman Spring-Filled Corporation, Chicago, Ill., a corporation of Illinois.

The invention relates to an attachment for wooden chair frames and comprises a yielding or spring back adapted to be secured to the frame and to carry a spring-filled cushion to provide a back support which will conform to the contour of the back and shoulders of an occupant and which will swing backwardly to a limited degree under the pressure exerted against the cushion.

✦ ✦ ✦

No. 2,109,762, FILAMENT FOR INCANDESCENT LAMPS, Patented March 1, 1938 by Shiro Abe, Nada-ku, Kobe, Kazuo Setoguchi, Motoyama-mura, Muko-gun, Hyogo-ken, and Toyota Nagai, Suma-ku, Kobe, Japan, assignors to Kabushiki, Kaisha Kawanishi Kikai Seisakujo, Hayashida-ku-Koke, Japan, a corporation of Japan.

A substantially non-sagging and non-twisting filament is produced by mixing pure tungsten metal particles with tungsten particles coated with lower tungsten oxide film, sintering the mixture into an ingot and reducing the oxide-coated particles to large pure tungsten metal particles, and then working the pure tungsten ingot into the form of a filament.

✦ ✦ ✦

No. 2,109,764, UPHOLSTERED SPRING CONSTRUCTION, Patented March 1, 1938 by George R. Beatty, Jackson, Mich., assignor to Reynolds Spring Company, Jackson, Mich., a corporation of Delaware.

An arrangement for readily securing the springs and lower edge of the upholstery is provided by a base frame comprising a channel member having two laterally and inwardly facing open channels one above the other, the springs being secured in the upper channel, and the upholstery edge being secured in the lower channel, which is provided with a restricted throat.

✦ ✦ ✦

No. 2,109,837, METHOD OF JOINING POWER TRANSMITTING CABLES, Patented March 1, 1938 by Lewis K. Davis, Hampton, N. J., assignor to Grace P. Davis, Hampton, N. J.

Encircling the abutting ends of two stranded cables to be joined is a metal

(Please turn to Page 256)

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

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A Review of Recent Wire Patents

(Continued from Page 255)

sleeve, supported for the greater portion of its cylindrical surface, the method consisting of forcing a portion of the unsupported part of the sleeve inwardly to compress and deform the strands whereby the strands and contracted sleeve form a solid mass.

✦ ✦ ✦

No. 2,110,065, SPRING ASSEMBLY FOR CUSHIONS AND MATTRESSES Patented March 1, 1938 by Henry F. Hager, Trenton, N. J.

In the end convolutions of adjacent coil springs outwardly-extending notch-forming bends are provided, in which are pivotally disposed the opposite ends of link wires, which latter are encircled by helical springs receiving in their ends the notch formations, one of the objects being to provide an assembly having uniform hinge action on all four sides of the coil springs.

✦ ✦ ✦

No. 2,110,150, WIRE HINGE FASTENER, Patented March 8, 1938 by Leslie M. Hile, Benton Harbor, Michigan.

Two inter-engaging wire staple-like members are inserted in the adjacent edges of a folding box or crate, to form a hinge-like connection, the inter-engaging portion being disposed inside the box or crate, the head of one of the staple-like members being expanded laterally so as to not pull through the head of the companion member.

✦ ✦ ✦

No. 2,110,665, WIREWORKING MACHINE, Patented March 8, 1938 by Bernard Heilman and Earl Peck, Detroit, Michigan, assignors to L. A. Young Spring & Wire Corporation, Detroit, Michigan.

A coil forming machine is provided which may be adjusted to produce coils having a wide range in shape and size, the form control being through threaded or screw adjustments. The length of wire fed during each cycle of the machine is determined by the relative adjustment of a pair of cam members, which raise and lower a floating drive shaft into and out of driving engagement with the wire.

✦ ✦ ✦

No. 2,110,726, METAL SHELF FOR REFRIGERATORS, OVENS, AND THE LIKE, Patented March 8, 1938 by Olin E. Harvey, Battle Creek, Mich., assignor to United Steel & Wire Company, Battle Creek, Michigan.

Formed of rod material of circular cross-section is an endless rectangular border frame comprising front, rear and end members. An intermediate bar is butt-welded at its ends to the inner sides of the end members of the frame with the top of the intermediate bar below the plane of the top of the frame. Parallel wire slats are at their rear ends disposed on the top of the rear frame member and at their front ends butt-welded to the front frame member to provide a rounded guiding surface at the front of the shelf.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

No. 2,110,793, WIREWORKING MACHINE, Patented March 8, 1938 by Ezra A. Frantz, Weatherford, Texas.

For producing wire bale tie buckles, a machine is provided with a common shaft adapted to continuously rotate with a plurality of wheels and cams that direct and form the bends of the buckle and sever the same from the wire stock, the machine having a combined die, holder and cutter for the wire.

✦ ✦ ✦

No. 2,111,651, HIGH-FREQUENCY TRANSMISSION SYSTEM, Patented March 22, 1938 by Jesse F. Wentz, New York, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York.

As a means and method of excluding extraneous voltages from a transmission system embodying co-axial conductors, and for reducing cross-talk in a system of the concentric type, the free ends of steel tapes enveloping the co-axial conductor are soldered to the outer conductor on which is established an equi-potential condition independent of the circuit carrying the high-frequency currents, whereby induced voltages in the steel tapes will be short circuited.

✦ ✦ ✦

No. 2,111,826, GALVANIZING PROCESS. Patented March 22, 1938 by Adolph H. Waltman and Paul W. Dillon, Sterling, Ill., assignors to Northwestern Barb Wire Company, Sterling, Ill., a corporation of Illinois.

For galvanizing hard drawn steel wires, the wires are bathed in molten zinc at between 850°-950°F., then bathed in molten lead at between 1100°-1400° F. and subsequently bathed in relatively pure zinc to form a bright coating.

✦ ✦ ✦

No. 2,112,088, MUSICAL INSTRUMENT STRING, Patented March 22, 1938 by Raymond S. Gould, Jr., Battle Creek, Mich., assignor to V. C. Squier Company, Battle Creek, Michigan.

Longitudinally disposed parallel strands of straight fine wire are provided with a sheath of longitudinally disposed strands of silk, over which a spirally wound compressive wire covering is formed, whereby to provide a string not affected by atmospheric conditions.

✦ ✦ ✦

No. 2,112,322, CABLE, Patented March 29, 1938 by Kenneth S. Wyatt, Detroit, Mich., assignor to The Detroit Edison Company, Detroit, Mich., a corporation of New York.

The invention proposes to reduce the harmful effect of products impairing the electrical characteristics of an insulated cable by locating within the insulating material agents adapted to adsorb these products. Examples of such agents are activated charcoal, dehydrated silicic acid, dehydrated ferric hydroxide gel, and exploded cellulose fibers.

No. 2,112,700, SPIRAL FABRIC HAVING SPACERS FOR THE SPIRALS, Patented March 29, 1938 by Vernon C. King, Worcester, Mass., assignor, by mesne assignments, to Wickwire Spencer Steel Company, a corporation of Delaware.

Disposed within the spirals of a spiral wire fabric are yielding spacers operatively interengaged with the spirals to maintain the same in normally assembled relationship against relative movement. The fabric may include parallel connector wires interengaging the spiral wires, and between which the yielding spacers may be interposed.

✦ ✦ ✦

No. 2,112,740, HIGH TENSION GAS FILLED CABLE, Patented March 29, 1938 by Paul E. Humphrey, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York.

Insulative rods are secured within a gas-filled pipe and oblique or askew to the longitudinal axis thereof, for supporting in spaced relation, a plurality of uninsulated conductors in the pipe.

✦ ✦ ✦

No. 2,110,287, SPLICING MACHINE, Patented March 8, 1938 by James W. Channell, West Los Angeles, California.

The invention provides wire twisting apparatus for splicing the wires of telephone cable, and is an improvement in the splicing machine disclosed in U. S. patent 1,813,562, the feature of the present invention being the provision of a machine which will simultaneously make a pair of joints which are staggered on straight or multiple splices and position a single sleeve over these joints.

✦ ✦ ✦

Reissue No. 20,673, WIRE OR STRIP TINNING MACHINE, Patented March 15, 1938 by Charles W. Meyers, Cleveland, Ohio.

Means is provided for feeding a wire through molten tin and thence upwardly through palm oil floating on the tin, an electric induction heater being immersed in the palm oil capable of raising the temperature of the wire without materially raising the temperature of the palm oil or harming the tin coating on the wire.

✦ ✦ ✦

No. 2,111,026, SPRING MATTRESS, Patented March 15, 1938 by William Lewis, Utica, N. Y.

In a construction involving the use of coil springs arranged side by side in parallel rows and the springs of each row in spaced relation, helical tie springs extend along the contiguous sides of the springs of adjacent rows and are interlaced with the end convolutions thereof, these helical tie springs being of reduced diameter at their interlacing portions to hold the end convolutions against circumferential or radial movement.

✦ ✦ ✦

No. 2,111,115, WIRE TYING MACHINE, Patented March 15, 1938 by Harold John Gibbs, Thomas Alexander Bingham, and David William Bingham, Melbourne, Australia, assignors to Gerrard Wire Tying Machines Company

Propietary Limited, West Melbourne, Australia.

The machine is of the kind wherein wire led around a bale or case is tensioned and the overlapped end portions of the wire are secured together by twisting. The functions of tensioning, twisting and cutting the wire are brought about during continuous turning of a main shaft in one direction, and the machine is adapted for hand or power operation.

✦ ✦ ✦

No. 2,111,229, SHIELDED WIRE COVERING. Patented March 15, 1938 by Harry E. Thompson, Providence, R. I., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

Encircling the insulated conductor is a jacket of interconnected copper and fibrous strands and a layer of metallic particles conductively co-acting with the copper strands to form a shielding envelope, the particles being interspersed throughout a binder characterized by flexibility and resistance to the destructive effect of water, oil and gasoline.

✦ ✦ ✦

No. 2,111,363, SPRING ASSEMBLING MECHANISM, Patented March 15, 1938 by Edward M. Gardner, Cicero, Ill.

Mechanism is provided to assemble spiral upholstery springs by tying with helical connector springs, and includes a driving cam with which one end of the connector wire is secured for weaving the wire into the upholstery springs, and means for advancing the connector wire step by step, the number of turns imparted to the wire during each step depending on the spacing of the springs to be assembled.

✦ ✦ ✦

No. 2,111,409, ELECTRIC CABLE, Patented March 15, 1938 by Carl H. Seaberg, Stratford, Conn., assignor to General Electric Company, a corporation of New York.

Encircling a plurality of rubber covered conductors is a rubber sleeve, covered by a braid and lacquer jacket, surrounded by a varnished cloth tape, over which is disposed a second braid and lacquer jacket, and a second varnished cloth tape covering, and finally a metal armor over the second tape covering.

✦ ✦ ✦

No. 2,111,426, METHOD AND APPARATUS FOR WELDING WIRES, Patented March 15, 1938 by Wilhelm Hilbert, Berlin-Lichtenberg, Germany, assignor to General Electric Company, a corporation of New York.

In manufacturing a four-part lead wire for electric lamps, ends of a fuse lead and an outer lead are welded to opposite ends of a press lead to form a three-part lead wire, which is dropped into an inclined trough to one side of a stop plate. Toward the opposite side of the stop plate, an outer lead wire is advanced, the stop plate being then removed and the ends of the three-part and outer lead wires heated, so that when moved together they will become welded.

✦ ✦ ✦

No. 2,111,448, FRAME FOR WIRE MESH FABRIC, Patented March 15, 1938 by Charles J. Hoffman, York, Pa.

The individual strands of diamond mesh fabric are crimped so that the effective thickness varies, and to produce a panel, the fabric is cut to the desired rectangular size, and tubular channel bars are slid lengthwise of each marginal edge so that the restricted throat of the bars will engage the fabric, after which the bars are united by corner plates.

✦ ✦ ✦

No. 2,111,496, DISPLAY AND DISPENSING RACK, Patented March 15, 1938 by John M. Scriba, Chicago, Ill., assignor to Midland Wire & Metal Products, Chicago, Ill., a corporation of Ill.

In this rack the packages are displayed in rows so that when the front package of a row is removed, a spring-urged follower slides the remaining packages forward. It is stated that the device may be made almost entirely of wire, although the frame structure may advantageously be formed of flat strips.

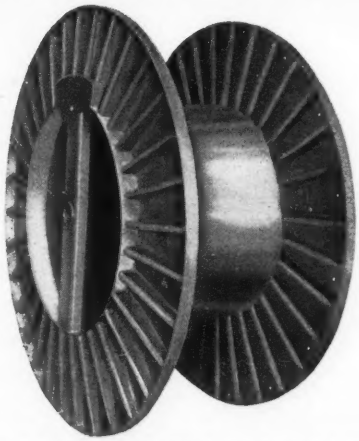
No. 2,111,630, STRAND HANDLING APPARATUS, Patented March 22, 1938 by Fred V. Johnson and Edgar U. Rice, Baltimore, Md., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

One embodiment of the invention contemplates a co-axial conductor assembling apparatus having means to examine and test a central conductor with insulating discs postioned at perdetermined intervals thereon, means to apply a plurality of Z-shaped tapes of metal over the discs, means to reduce disturbing vibration of the nascent co-axial pair, means to apply a protective sheath over the outer conductor, and means to detect short circuits between the two conductors of the pair.

FOR ECONOMY

INVESTIGATE

STEVENS *LOW-TARE* STEEL SHIPPING REELS



MADE OF HIGH TENSILE STRENGTH STEELS

LOW WEIGHT

PLUS

LONG LIFE

WHAT STEVENS *LOW-TARE* REEL ECONOMY MEANS FOR ONE USER

	STD REEL WITH WOODEN HEADS AND STEEL DRUM	STEVENS *LOW-TARE* STEEL REEL	SAVING IN WEIGHT ON EVERY SHIPMENT
SIZE A	358#	225#	133#
SIZE B	470#	300#	170#
SIZE C	692#	520#	172#

THIS SAVING IN FREIGHT COST

PLUS

A MINIMUM LIFE OF TWELVE YEARS

STEVENS METAL PRODUCTS CO.

NILES, OHIO

WIRE

To consider your special needs and problems in wire, all the skill and experience of our metallurgists are at your command. Perhaps—as has happened with many manufacturers—they can point the way to faster work, fewer rejections, lower costs, and a better, more dependable product. As specialists in low-carbon wire we often can furnish a combination of analysis and temper that simplifies fabrication and improves strength in the final product.

Besides special-analysis and copper-bearing steel wire Continental — and only Continental—offers wire of Konik, the patented new steel containing copper, nickel, and chromium. Konik's amazing amenability to carburizing and heat-treatment permits new peaks of hardness, toughness, and resistance to abrasion. Its economies have been proved in four years of use by a variety of manufacturers.

Among the finishes offered by Continental are bright, bright and black annealed; sull-coated; processed; galvanized, including Flame-Sealed; liquored, coppered and tinned in many modifications. Eight shapes are standard, and many specials available. Regular gauges run from No. 34 to 5/8 inch. Furnished in coils of suitable sizes, or cut and straightened to specification.

CONTINENTAL STEEL CORPORATION

General Offices: Kokomo, Indiana • Plants at Canton, Kokomo, Indianapolis

CONTINENTAL

STEEL SHEETS AND WIRE PRODUCTS

Wire: Bright Basic, Annealed, *Konik, Special Manufacturers, Galvanized, *Flame-Sealed

Wire Rods, Nails, Staples, Bale Ties, Barbed Wire; Fence — 15 Types; Gates and Fittings

Sheets: Black, Galvanized, Special Coated; Roofing and Siding—14 Styles

*Trade Mark Registered, U. S. Patent Office

The Effect of Longitudinal Scratches On Valve Spring Wire

(*Continued from Page 249*)

was repeated until no further deformation in the test specimens was noted. In no case did it have to be repeated more than twice, unless as a precaution to make sure that the stress cycle had not changed. As mentioned previously, after the first few hours of the test, the stress cycle did not change appreciably. This was found to be true by repeating the above procedure at the completion of the test in cases where the test specimen did not fail.

✦ ✦ ✦

THREE specimens were tested at each stress for every type of scratch. The failure of two out of three specimens determined that the stress was above the endurance limit. If two of the three specimens did not fail, it was concluded that the maximum stress was below the endurance limit.

✦ ✦ ✦

Measurement of Scratches

THE tools used for making scratches were made of high speed steel, Stellite or diamond. The angles of the high speed steel tools were 15, 30, and 45 degrees. The Stellite tool and the diamond tool each had 30-degree angles. Although these tools had angles as stated, this gave no indication as to the contours of scratches made by the tools, for every time a scratch was made, a certain amount of the tool point would be worn away and the resulting scratch might have an entirely different contour than the original one of the tool. For the same reason, no accurate idea could be formed of the depth of the scratch, even though the tool was fed a definite distance into the test specimen. It was therefore necessary to devise a method to determine accurately the shape and depth of the scratches after they were made.

✦ ✦ ✦

AFTER trying several methods, the following one was adopted: The test specimen was cut in two about 0.06 inch from the point at which it was desired to examine

the scratch. The piece of the specimen was heavily plated with copper. The thickness of the copper plate was not less than 0.02 inch. The piece was then mounted vertically on a steel ring. About 0.06 inch was then ground off the ring and the specimen. This brought the point at which the scratch was to be examined very near the ground surface. The piece was then given a metallographic polish so that it could be examined under the microscope. Photomicrographs were then made of the scratch and from these it was possible to accurately study the contours and depths of the scratches. This same procedure was used to examine the scratches found on commercial spring wire.

The Bibliography referred to in this article will be published at the end of Part II in the June issue of WIRE & WIRE PRODUCTS.

Metal Sprayed Surfaces in Relation to Lubrication

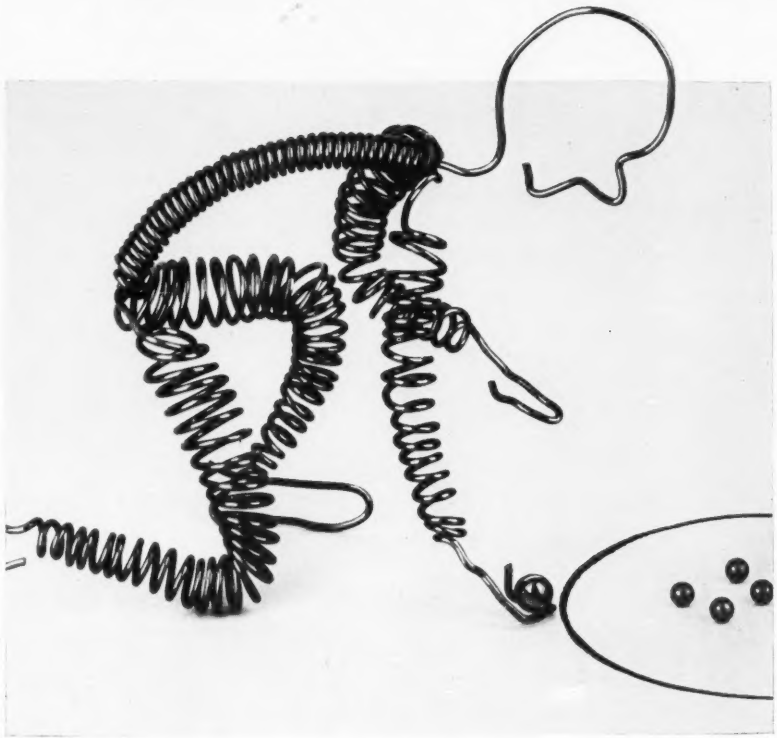
THIS is the title of a paper by Harry Shaw, Consulting Engineer, read before the Metallizing Engineering Association at Manchester, England, October 20th, 1937, and reprinted by the Metallizing Engineering Co., Inc., 44 Whitehall Street, New York, N. Y.

✦ ✦ ✦

IT is an interesting technical presentation of the subject, and copies of the paper may be obtained without charge by addressing the Metallizing Engineering Co., Inc. at the address noted above.

Make Your Plans Now to Attend The Wire Association Meeting in October, 1938 at Detroit, Mich.

Knuckles Down



..and wins for You!

Keystone wire knuckles down in your plant and proceeds to knock out the orders with smooth precision. That's because it's wire perfectly suited to your requirements, in analysis, temper, form, finish . . . every detail that will help you make the best product at the least cost. You state the rules of the game—and Keystone will send you a wire that will win. It's your shot!

KEYSTONE

STEEL & WIRE CO., Dept. W, PEORIA, ILL.

HIGH CARBON or LOW CARBON

SAMSON SPRING WIRE
REG. U.S. PAT. OFF.
KEYSTONE STEEL & WIRE CO. PEORIA, ILL.

Bright . . . Tinned
Coppered
Annealed
Galvanized

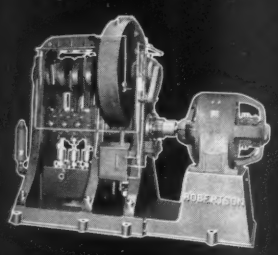
A SUMMER AT THE SHORE

on the savings it makes!

14 DISTINCTIVE FEATURES are saving many dollars annually for users of Robertson High Pressure Hydraulic Pumps. World-wide test of Robertson efficiency demonstrates conclusively unusual economy in operation and in maintenance.

Any Robertson user can tell you as much.

We'll be glad to refer you to the Leaders who know . . . send you complete description and data on the features of this Pump . . . work closely with you in any way possible. Just write us on your letterhead. No obligation at all.



ROBERTSON

HYDRAULIC PUMP

JOHN ROBERTSON COMPANY, INC.

125-137 Water Street, Brooklyn, N. Y.

An Investigation of the Use of Back Pull in Wire Drawing

(*Continued from Page 233*)

SUBSTITUTING Σ and Σ_0 for the values $(p + q)$ at the entry and exit of the die respectively, **equation (2)** becomes:

$$(x + \tfrac{1}{2} D_0 \cot \alpha) \frac{dp}{dx} - 2 \mu \cot \alpha \, p + 2 \left[(1 + \mu \cot \alpha) \, \Sigma_0 - (1 + \mu \cot \alpha) \frac{(\Sigma_0 - \Sigma_1)}{l} x \right] = 0 \tag{3}$$

* * *

THIS differential equation can be solved, assuming $R_0 = \tfrac{1}{2} D_0$ and becomes:

$$p = C \, (x + R_0 \cot \alpha)^{2 \mu \cot \alpha} + \left(\frac{1 + \mu \cot \alpha}{\mu \cot \alpha} \right) \left[\Sigma_0 - \left(\frac{\Sigma_0 - \Sigma_1}{l} \right) x + \left(\frac{\Sigma_0 - \Sigma_1}{l} \right) \left(\frac{x + R_0 \cot \alpha}{1 + 2 \mu \cot \alpha} \right) \right]$$

And if it is conceded that at the entrance of the die, that is for $x = 1$, $p = p_1$, the **equation (3)** becomes:

$$p = \left(\frac{1 + \mu \cot \alpha}{\mu \cot \alpha} \right) \left[\Sigma_0 - \frac{(\Sigma_0 - \Sigma_1)}{l} x + \frac{(\Sigma_0 - \Sigma_1)}{l} \frac{(x + R_0 \cot \alpha)}{(1 - 2 \mu \cot \alpha)} \right] + \left[p_1 - \left(\frac{1 + \mu \cot \alpha}{\mu \cot \alpha} \right) \left(\Sigma_1 + \frac{(\Sigma_0 - \Sigma_1)}{l} \frac{(1 + R_0 \cot \alpha)}{(1 - 2 \mu \cot \alpha)} \right) \right] \left(\frac{x + R_0 \cot \alpha}{1 + R_0 \cot \alpha} \right)^{2 \mu \cot \alpha} \tag{4}$$

This equation can be simplified considerably by assuming that $p + q$ is constant rather than uniformly varying from entrance to

exit. This makes $\Sigma_0 = \Sigma_1 = \Sigma$ and equation (4) becomes:

$$p = \frac{(1 + \mu \cot \alpha)}{\mu \cot \alpha} \Sigma + \left[p_1 - \frac{(1 + \mu \cot \alpha)}{\mu \cot \alpha} \Sigma \right] \left(\frac{x + R_0 \cot \alpha}{1 + R_0 \cot \alpha} \right)^{2 \mu \cot \alpha}$$

and if it is further conceded that $p_1 = 0$, it is found that for $x = 0$, that is to say for the die pull F, the value is as indicated by Sachs (Zeitschrift für Angewandte Mathematik und Mechanik, 1927, Vol. VII, p. 235):

$$F = \Sigma \left(\frac{1 + \mu \cot \alpha}{\mu \cot \alpha} \right) \left[1 - \left(\frac{R_0 \cot \alpha}{1 + R_0 \cot \alpha} \right)^{2 \mu \cot \alpha} \right]$$

whence

$$F = \Sigma \left(\frac{1 + \mu \cot \alpha}{\mu \cot \alpha} \right) \left[1 - \left(\frac{R_0}{R_1} \right)^{2 \mu \cot \alpha} \right] \quad (5)$$

✦ ✦ ✦

MANY authors have undertaken to check equation (5) but unfortunately this calls for the determination of actual values of μ and Σ.

✦ ✦ ✦

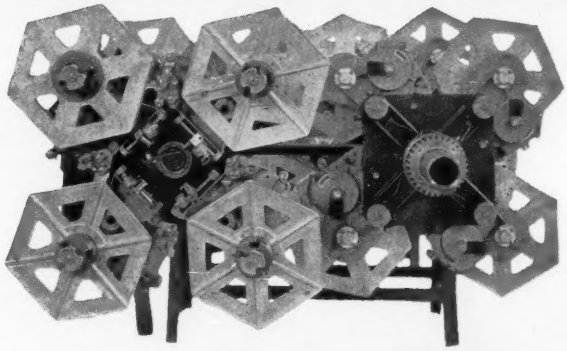
HORSBURGH found enormous variations in the coefficient of friction μ with changes of draft. Moreover, it was most peculiar to see μ increase and q decrease at the same time. The only explanation is that the assumptions on which the formula was set up are false. One glaring fallacy is that the stresses are assumed to be principal, where it is evident that there are shear stresses set up parallel to the cone of the die.

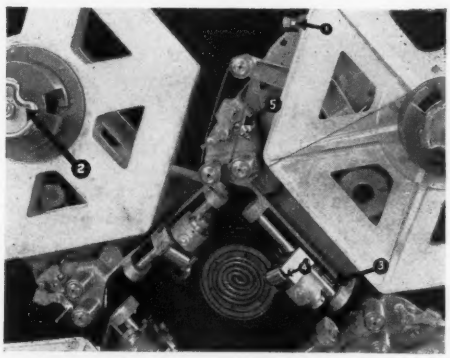
✦ ✦ ✦

ONLY two papers have been presented on the use of back pull. Both however emphasized the power requirement phase of employing back tension. No published research has yet been done

(*Please turn to Page 262*)

Paper Taping Heads for Cables





ES

The Following Features are Embodied:

1 - Positive preset tape tension control throughout entire package.

2 - Tape plates are adjustable to center tape package.

3 - Each tape can be longitudinally adjustable in micrometer fashion to establish desired relations between the tapes. This adjustment is provided with positive means for locking the device after adjustment is made.

4 - Swivel adjustment for various diameter cables to insure uniform tension over entire width of tape.

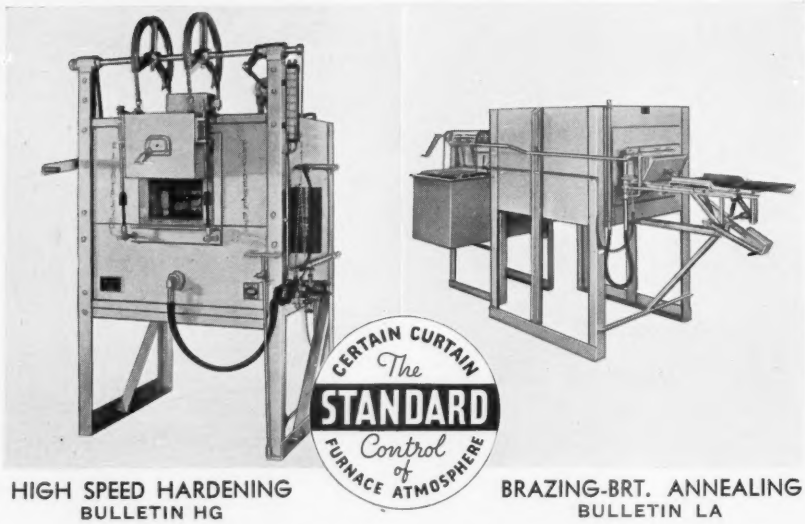
5 - Automatic stops on each device to interrupt machine when paper terminates. These stops can be locked out when any one device is not being used.

ELEVATOR
SUPPLIES COMPANY, Inc.

RAHWAY, N. J.

EXECUTIVE AND SALES OFFICE
420 LEXINGTON AVE., NEW YORK, N. Y.

WORKS
RAHWAY, N. J.



HIGH SPEED HARDENING
BULLETIN HG

BRAZING-BRT. ANNEALING
BULLETIN LA

Whatever controlled-atmosphere furnace you need, consider the apparatus that has established a new high standard of performance in the most difficult field; high speed tool work. For 10 years patented Certain Curtain design has produced cleaner finish at lower cost in a wide range of hand fed and continuous apparatus for ferrous and non-ferrous work.

For bulletins write **C. I. HAYES, INC.**

129 BAKER ST., PROVIDENCE, R. I. ESTABLISHED 1905

Error In Published Brown & Sharpe Wire Gauge Equivalents

MR. W. D. Pierson, Secretary of the Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn., calls attention to an error in the published Brown & Sharpe Wire Gauge equivalents which will undoubtedly be of interest to all in the wire industry. Mr. Pierson states:

"An example of how an error may be repeated over and over again for a long period is presented in the published Brown & Sharpe Wire Gauge equivalents.

As far as the writer has been able to determine, this error occurs in all the standard handbooks, publications, etc., and evidently the mistake was started years ago by someone and copied.

In checking over elongations an inconsistency occurred in Sizes # 49 and #50 and in order to get at the bottom of the matter I wrote to the Brown & Sharpe Manufacturing Company, who unquestionably should be the last word. Their librarian very kindly sent me the decimal equivalents for the fine sizes.

In the following tabulation the handbook decimal equivalents are shown in the left hand column to five decimal places, and in the right hand column the true Brown & Sharpe equivalents to six decimal places.

#45	.00176	.001761
#46	.00157	.001568
#47	.00140	.001397
#48	.00124	.001244
#49	.00099	.001108
#50	.00088	.000986
		.000878

It will be noted that #49 and #50 in the handbook equivalents should be #50 and #51, and actually #49, equals .001108", is not given.

Of course, these fine sizes are not very generally used commercially, but at the same time it would be well to have the correction established."

POSITION WANTED

Plant Executive, technically trained chemical engineer with wide experience in plant operation, sales and development. Also practical experience in lead and galvanizing coatings and drawing lubrications.

For details address Box 106

WIRE & WIRE PRODUCTS

17 E. 42nd St. New York, N. Y.

WANTED

Capable wire forming machine set up man to take charge of department—give age, experience—references and wages expected.

Company 60 years in business in Ohio.

Address Box No. 105

WIRE AND WIRE PRODUCTS

17 E. 42nd St. New York, N. Y.

An Investigation of the Use of Back Pull in Wire Drawing

(Continued from Page 261)

on the effects of back pull on the physical properties of wire.

✦ ✦ ✦

I PRESENT extracts of both works for what they are worth:

"A Note on the Effect of a Backward Pull upon the Tension Required to Draw Wire" by **Professor F. C. Thompson,** The Victoria University of Manchester, paper of Iron and Steel Institute, autumn meeting 1933.

✦ ✦ ✦

THIS was an investigation to find what the effect of back tension was upon the tension required to draw wire. It was found that the tension is increased by back pulls. However, the writer states, "the work is not without its interest in demonstrating how great may be the reduction of the pressure on the die and hence presumably how its life may be increased. Especially with alloys which are hard and difficult to draw, this fact might conceivably have a certain practical value."

✦ ✦ ✦

ON the other hand, **Mr. Paul M. Mueller** engineer of the Revere Copper and Brass, Inc., N. Y. C., read a paper, **"Notes on the Use of Back-Pull in Wire Drawing"** at the Wire Association meeting of 1935. This was published in Wire and Wire Products, September, 1935. In his paper, he drew the following conclusions:

(1) Back pull is an important factor in wire drawing and should be investigated thoroughly.

(2) It must be taken into consideration in the analysis of power requirements for cascade drawing.

(3) Its effect is to reduce the pressure with which the metal may be crushed to a new size, thereby lowering parasitic friction and improving inherent low die efficiency.

(4) A specific design of drawing machine controlling the degree of back pull, shows a possible power saving of 25%.

(5) A revised design of a normal machine using larger reductions shows a power saving of 19%.

(6) It is conceivable that the partial elimination of friction in the die will improve die life and maintenance costs, and, through reduction in unit bearing pressure, permit the use of new lubricating means which are not at present permissible.

The Pittsburgh Regional Meeting

(*Continued from Page 238*)

changed by heat treatment and by the addition of alloying metals, Mr. McCarthy reviewed and discussed various specifications of wire products with emphasis on proper heat treatment and the addition of necessary alloys to meet customers' specifications.

✦ ✦ ✦

THE attendance was approximately 300 and the success of the meeting can be summed up by a comment made by Mr. Westphal:

"From my visit at Pittsburgh Steel from the Blast Furnaces and Open Hearths through all the subsequent operations to finished product, combined with the enthusiastic personnel of this company that guided us through, it was a day very well spent. In the evening to hear the two interesting technical papers, along with the interesting "off the record" discussion, it made it a complete program. Combined with the professional side of the meeting, as well as the cordial spirit and fraternization of the 281 people who registered throughout the day and night, I would say that this Second Regional meeting was a howling success."

✦ ✦ ✦

"Men Make Steel"

A PREVIEW of the first industrial sound motion picture in technicolor telling the story of steel making was presented by the United States Steel Corporation in the grand ballroom of the Waldorf-Astoria, New York City, on Wednesday, April 13th. Prior to the presentation of the picture, Edward R. Stettinius, chairman of the board of the United States Steel Corporation, described the cooperation required by the many departments of the organization to produce the film.

✦ ✦ ✦

THE production cost about $200,000 and is to be released to educational groups and U. S. Steel customers in the near future.

✦ ✦ ✦

THE narrator, Edwin C. Hill, the well-known radio commentator, explained in simple language the making of rails, axles, pipe, sheets and wire from the hot ingots to the finished product.

✦ ✦ ✦

THE film cannot be in any way regarded as a technical film

(*Please turn to Page 269*)

NORBIDE ABRASIVE . . .

for Cemented Carbide Dies

Used in place of diamond dust it reduces the cost of shaping, ripping and finishing.

NORTON COMPANY
WORCESTER, MASS.

N-36

NORTON ABRASIVES

BELL-MINE
ROTARY KILN
PULVERIZED
LIME

MANUFACTURED BY THE WARNER COMPANY (BELLEFONTE DIVISION) AT BELLEFONTE, PA. SALES OFFICES AT PITTSBURGH, NEW YORK CITY, PHILADELPHIA AND WILMINGTON

WARNER COMPANY — Lime — Bell Mine Products — BELLEFONTE DIVISION

for wire drawing

Do You, Too ... Like To Read Other People's Mail?

Then take a look at this:

A letter received March 23, 1938, from a consulting engineer specializing in mechanical and industrial design reads:

"I have had quite a bit of satisfactory experience in plants with your pumps and will appreciate copies of these bulletins:

1. Set of bulletins covering . . . . centrifugal pumps.
2. Bulletin No. 167 covering reciprocating pumps.
3. Bulletins covering complete line of valves.
4. Data, installation drawing . . . mixing nozzles.
5. Bulletins of physical and chemical data for your various alloys."

And then he asks questions about the handling of specific corrosive liquors. So, of course, we brought him up-to-date on Duriron Company Products.

Maybe you, too, have a hankering for some nice, fresh bulletins on acid handling equipment—such as pumps, valves, pipe, heat exchangers, steam jets, and metal alloys for corrosion-resisting equipment.

Doesn't take much to get them—just drop us a note.

THE DURIRON COMPANY, Inc.

445 N. Findlay Street **Dayton, Ohio**

PROCESS FOR SALE

A PROCESS is for sale either outright or on a royalty basis for drawing fine wire in the following materials:

Stainless steel (all analyses).
High carbon steel for spring wire.
High carbon steel for music wire.
Steels for rope wire.

✦ ✦ ✦

THE product, in all materials, will be killed perfectly (or dead) and can be cast perfectly to any predetermined diameter, the range of diameters depending upon the diameter of the finished block.

✦ ✦ ✦

MUSIC wire can be drawn to meet the clickless specifications.

✦ ✦ ✦

THE cost of drawing is considerably reduced, due principally to a substantial saving in die cost.

✦ ✦ ✦

FINISHING speeds are greater than those ordinarily used today.

✦ ✦ ✦

THE above are the outstanding features and further details will be supplied to interested and responsible inquirers. Address Box 108,

Wire & Wire Products

17 E. 42nd St., NEW YORK, N. Y.

Duronze Alloys

A NEW 80 page technical handbook covering the physical properties and applications of four high strength silicon bronzes pioneered by Bridgeport and sold under the trade name "Duronze Alloys" has just been released by the Bridgeport Brass Company, Bridgeport, Connecticut.

✦ ✦ ✦

WHILE possessing the common features of high copper silicon bronze, the four alloys which compose the Duronze group differ widely in their physical characteristics, methods of working and specific fields of application. The ever broadening range of industrial demands resulting partly because of the more severe requirements of modern industrial applications and the recognition that metals must stand up without the possibility of sudden failures and weakening due to wasting away from corrosion have made Duronze alloys outstanding in non-ferrous metallurgy. They rank in importance with the development of stainless steels in the ferrous industry.

✦ ✦ ✦

DURONZE Alloys are recommended for severe service in outdoor construction where steel, brass and copper are not strong enough or have sufficient corrosion resistance. They are not subject to corrosion or season cracking. Briefly the Duronze Alloys have the following properties and applications:

✦ ✦ ✦

DURONZE I has exceptionally fine cold working properties, its high strength being the result of cold drawing or rolling. Bolts and screws are made by cold heading hard drawn rod or wire. Smaller sizes of bolts and screws average over 100,000 lbs. per sq. in. in tensile strength.

✦ ✦ ✦

DURONZE II has the strength and toughness of mild steel plus the corrosion resistance of fine bronze. Hot rolled sheets are excellent for making non-rusting tanks, range boilers and automatic heaters by the welding process.

FURNACES

for heat treating

WIRE

Improved physical properties, dependable uniformity, cleaner surface of the product—these advantages in addition to the lowest operating cost per ton of production have caused many of the largest wire mills in this country to standardize on Surface Combustion gas-fired furnaces. SC furnaces for heat treating wire include patenting, annealing, hardening, spheroidizing and galvanizing equipment. For producing controlled atmospheres, SC DX gas preparation units are available in 250 to 20,000 cu. ft. per hour capacities, and may be used with present furnaces by providing a muffle for the work. Ask for further information.

SC

SURFACE COMBUSTION CORPORATION

TOLEDO, OHIO

PREMIER

Premier

TRADE MARK REG. U.S. PAT. OFF.

Diamond Dies

Long Life is assured when you use Premier Diamond Dies because the die channel of the diamond is of such design that when it has been polished to the next diameter a perfect die is obtained again.

DRIVER-HARRIS COMPANY

HARRISON - NEW JERSEY

Cold rolled strip has fine spring qualities and is often used in place of phosphor bronze spring material.

✦ ✦ ✦

DURONZE III is a hot working alloy that is surprisingly strong and hard yet quite free machining. It hot forges readily and is excellent for making high strength forgings and screw machine parts. Forgings average 90,000 lbs. per sq. in. in tensile strength while screw machine items are closer to 100,000 lbs. per sq. in. in tensile strength. Both values are remarkably high for non-ferrous alloys.

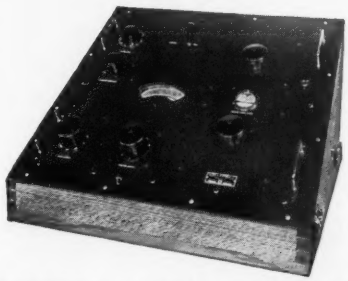
✦ ✦ ✦

DURONZE IV is supplied in tube form and is recommended for the manufacture of condenser tubes to resist corrosion under conditions which destroy ordinary materials. It is recommended for resisting impingement corrosion from aerated sea water and is finding greater application in salt refineries because of its resistance to corrosion from strong alkaline solutions.

✦ ✦ ✦

BESIDES containing many detailed tables and curves giving physical characteristics and applications, the Duronze Manual gives tables on corrosion resistance, machinability data, welding practices and weight tables. It is, in effect, a metallurgical text book on the silicon bronze. No manual can serve as an adequate substitute for the advice and cooperation of a highly skilled metallurgical staff. The user of non-ferrous alloys will find in the Duronze Manual a wealth of information on the properties and applications of this unusual group of high strength corrosion resisting silicon bronzes. Copies of the Duronze Manual may be obtained without charge by writing on company stationery to the Editor of Wire & Wire Products.

Make Your Plans Now to Attend The Wire Association Meeting in October, 1938 at Detroit, Mich.



TESTS INSULATION OF HIGH VOLTAGE POWER CABLES

Dielectric quality of insulation of high-voltage power cables is easily and rapidly measured with this power-factor measuring equipment. Cable may be tested in reel lengths on a production basis. Instrument reads directly in per cent power factor; operator need not be an instrument man.

Current range is from 0.0005 to 5.0 amperes. The corresponding capacitance range is from 13 mmf to 0.13 mf at 100 KV, 60 cycles; or approximately 400 mmf to 4.0 mf at 3000 volts, 60 cycles.

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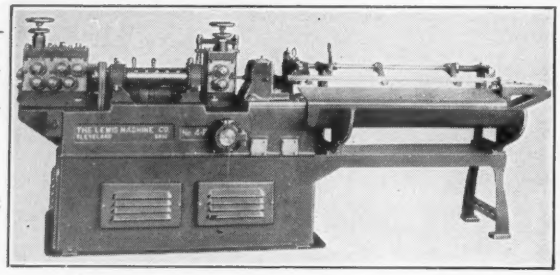

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Duriron Issues Chart for Selecting Sizes of Jets for Heating Liquids

A NEW bulletin on steam jets, ejectors, tank outlets and spray nozzles has just been issued by The Duriron Company, of Dayton, Ohio.

✦ ✦ ✦

THE bulletin is illustrated with photographs and dimension drawings of the equipment. Capacity tables are given where applicable.

✦ ✦ ✦

A COPYRIGHTED chart simplifies the selection of the correct size jet for heating any volume of liquid, with steam pressures varying from 15 lbs. to 85 lbs. The steam consumption in pounds per hour is automatically computed at the same time.

✦ ✦ ✦

ALSO illustrated is a novel method of emptying lined tanks when piercing of the tank bottom for an outlet is to be avoided. The Duriron siphon is made to order to fit the tank and can be installed in old as well as new tanks.

✦ ✦ ✦

COPIES of the bulletin will be sent free on request to readers of this magazine.

✦ ✦ ✦

Simplex Wire & Cable Co. Personnel Changes

W. C. Davis, former sales manager of Simplex Wire & Cable Co., Cambridge, Mass., associated with the company for the last 41 years, has been made vice president, and is succeeded by G. L. Roberts, who was assistant sales manager since 1927. G. A. Grauer becomes assistant sales manager.

Buffalo Bolt Co. Installs Second Radiant Tube Annealing Cover

(*Continued from Page 243*)

moved and placed over a stack of coils loaded on another base which has previously been prepared. An insulated cooling cover is then lowered over the inner cover of the heated load. Figure 2 shows cooling cover in place on base #4. A complete cycle of change takes only four minutes at the most and reduces to a minimum the loss of heat in the heating cover and the load from which the cover has been removed. The charge under the cooling cover for spheroidizing is controlled to a drop in temperature of 50° per hour. In this installation the amount of spheroidization is consistently running 70% or better on carbon and alloy steels.

✦ ✦ ✦

THE flexibility of the radiant tube heating cover makes it adaptable to spheroidizing or normalizing of carbon steels as may be desired. It is a known fact, however, that normalizing does not suffice for the alloy steels. Recourse must be, therefore, taken to the spheroidized treatment to obtain the necessary plasticity and softness required for economical cold heading. It is said that such a treatment for alloy steels results in a more economical die life and uniform structure in the final heat treatment.

✦ ✦ ✦

THE annealing covers were designed, fabricated and installed by the Surface Combustion Corporation of Toledo, Ohio.

Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested, additional information will be supplied promptly. Simply address:

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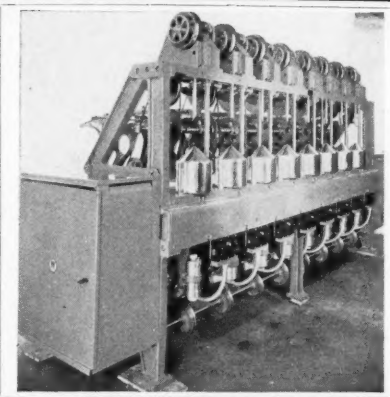

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* * *

Write for literature to John P. O'Brien, Mgr.

Exports and Imports

(*Continued from Page 251*)

500 square feet in comparison with 1,236,100 square feet. The supplying countries were Germany (467,500 square feet), and Belgium (315,000 square feet).

✦ ✦ ✦

WIRE CLOTH AND SCREENING receipts amounted to 48,201 square feet against 52,363 square feet, and were taken chiefly from Germany (20,323 square feet), Canada (15,809 square feet), and France (7,091 square feet).

✦ ✦ ✦

IMPORTS of FOURDRINIER AND OTHER PAPER-MAKING WIRES at 31,502 square feet compared with 29,618 square feet in January, and came from Germany (24,209 square feet), Austria (4,848 square feet), and France (2,445 square feet).

EXPORTS of iron and steel wood screws during February, 1938 totaled 10,249 gross valued at $2,131. Of this total Mexico took 3,400 gross valued at $601; Peru 995 gross valued at $187; Costa Rica 952 gross valued at $117; New Zealand 949 gross valued at $447; Brazil 723 gross valued at $108.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 2,751 gross valued at $1,696. Of this total Panama took 1,250 gross valued at $866; Bermuda 466 gross valued at $180; Canada 228 gross valued at $134; Finland 192 gross valued at $147; Colombia 180 gross valued at $89.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 26,357 gross valued at $1,995. Of this total Japan supplied 13,350 gross valued at $690; Austria 6530 gross valued at $710; Italy 3,400 gross valued at $279; Germany 2,910 gross valued at $270.

✦ ✦ ✦

Seeing the Surface

RESEARCH engineers at the Westinghouse Electric & Manufacturing Company have made it possible to get a profile view of a surface without destroying the sample by sectioning it as has been the usual method in the past.

✦ ✦ ✦

A STRAIGHT edge of a small strip of steel is placed against the surface. A beam of light is thrown on the surface, and the shadow of the straight edge is then observed with a microscope. By proper selection of the angles of illumination and viewing, the shape of the observed shadow is made geometrically equivalent to the shape of the profile of the surface. Irregularities as small as 0.00005 inch in depth can be studied by this method. The operations involved in making an observation are very simple, as the straight edge and light source are attached to the microscope objective and it is necessary only to properly place the sample and then focus the microscope.

✦ ✦ ✦

THE increasing emphasis on accurate machine work, higher standards of bearing importance has placed greater importance on surface finishes and hence the value of this new method of comparing surfaces.

✦ ✦ ✦

Talon Inc., Elects New Officers

WALLACE D. WALKER has been elected president of Talon, Inc., formerly known as the Hookless Fastener Co., manufacturer of metal slide fasteners, with plants in Meadville and Erie, Pa. He succeeds his father, the late Col. Lewis Walker, who died late in January. Other officers chosen are: Vice president, T. F. Soles; vice president and secretary, W. C. Arthur, and treasurer, P. K. Poulton.

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FOR SALE
I Waterbury Farrel #2-10 die upright rolled Wire Drawing Machine. Practically new. Will sacrifice. Address Box 699, Waterbury, Conn.

Men Make Steel

(*Continued from Page 263*)

but is rather an educational effort to demonstrate to both employees of the corporation and the general public the widespread ramifications of the steel industry.

✦ ✦ ✦

THE important role of the worker, safety conditions and checking methods to attain quality production were among the points emphasized in the picture.

✦ ✦ ✦

A ONE-REEL version of the film was also previewed and this will be used where time requirements are an element in the showing of the film. All together, the film marks a distinct advance in industrial education and is well worth seeing.

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WHERE TO BUY

For more complete information, consult the annual Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ANNEALING POTS AND BOXES—
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

ANTI-RUST—
Magnus Chemical Co., Garwood, N. J.

ARMORING EQUIPMENT—
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS—Rod and Wire
Morgan Construction Co., Worcester, Mass.

BOLT & NUT MACHINERY—Cold Forged
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CEMENT FLOOR CLEANER—
Magnus Chemical Co., Garwood, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.

CLEANERS—Hand and Metal
Magnus Chemical Co., Garwood, N. J.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

CONDUITS—Iron and Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONTROLS—Automatic
Leeds & Northrup Co., Philadelphia, Pa.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Cochaud Wire Die Co., New York, N. Y.
Driver-Harris Co., Harrison, N. J.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Rod and Tube Drawing
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Carboloy Co., Inc., Detroit, Mich.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Wire Drawing
Carboloy Co., Inc., Detroit, Mich.

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DRAW BENCHES—
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

ENGINEERS—Consulting Wire Mill
Lewis, Kenneth B., New York, N. Y.

EQUIPMENT—Insulation Testing
Leeds & Northrup Co., Philadelphia, Pa.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FURNACE CONTROLS — Combustion
Leeds & Northrup Co., Philadelphia, Pa.

FURNACE CONTROLS—Draft
Leeds & Northrup Co., Philadelphia, Pa.

FURNACES—Annealing
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia, Pa.
Surface Combustion Corp., Toledo, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia, Pa.
Surface Combustion Corp., Toledo, O.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Hayes, C. I., Inc., Providence, R. I.
Surface Combustion Corp., Toledo, O.

FURNACES—Electric
Electric Furnace Co., Salem, O.
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Hayes, C. I., Inc., Providence, R. I.
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FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, O.

FURNACES—Normalizing
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia, Pa.
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FURNACES—Wire, Strip & Sheet
Electric Furnace Co., Salem, O.
Surface Combustion Corp., Toledo, O.

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Gray Chemical Co., Roulette, Pa.

GRINDERS—Roll
Norton Co., Worcester, Mass.

HEADING MACHINERY—Cold
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

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INSTRUMENTS—Electrical
Leeds & Northrup Co., Philadelphia, Pa.

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E. W. Twitchell, Inc., Phila., Pa.

LATHES—Bench
Hardinge Brothers, Inc., Elmira, N. Y.

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Vaughn Machinery Co., Cuyahoga Falls, O.

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Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

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Watson Machine Co., Paterson, N. J.

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Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
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Amer. Insulating Mach'y Co., Phila., Pa.
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Torrington Mfg. Co., The, Torrington, Conn.
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Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

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Lewis Machine Co., The, Cleveland, O.
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Sleeper & Hartley, Inc., Worcester, Mass.

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MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Fidelity Machine Co., Philadelphia, Pa.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY — Measuring Wire & Cable
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
Amer. Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY— Special — Combination Machine for Drawing, Cutting-to-length. Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange, New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Stranding
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Fidelity Machine Co., Philadelphia, Pa.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Size of Wire
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Fall, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Amer. Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Rahway, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

MACHINERY—Wire Rope
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Rahway, N. J.

MACHINERY—Wrapping Wire
Elevator Supplies Co., Inc., Rahway, N. J.
W. A. Schuyler, New York, N. Y.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., The, Waterbury, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

PIPING AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

PYROMETERS—
Leeds & Northrup Co., Philadelphia, Pa.

RECORDERS—
Leeds & Northrup Co., Philadelphia, Pa.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS AND SPOOLS—Shipping and Shop
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H. Co., Homer, N. Y.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Fall, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
Amer. Insulating Mach'y Co., Phila., Pa.

WELDERS—Spot and Butt
Micro Products Co., Chicago, Ill.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

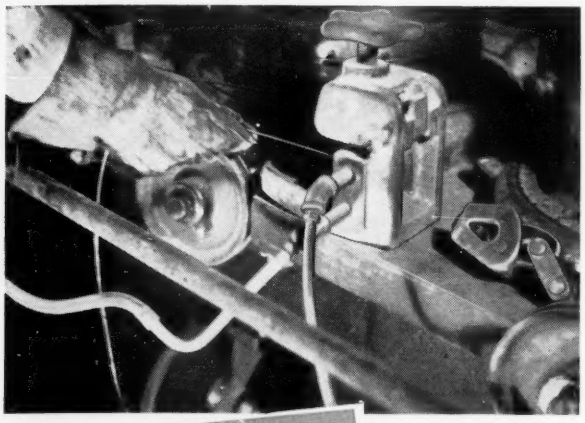
WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

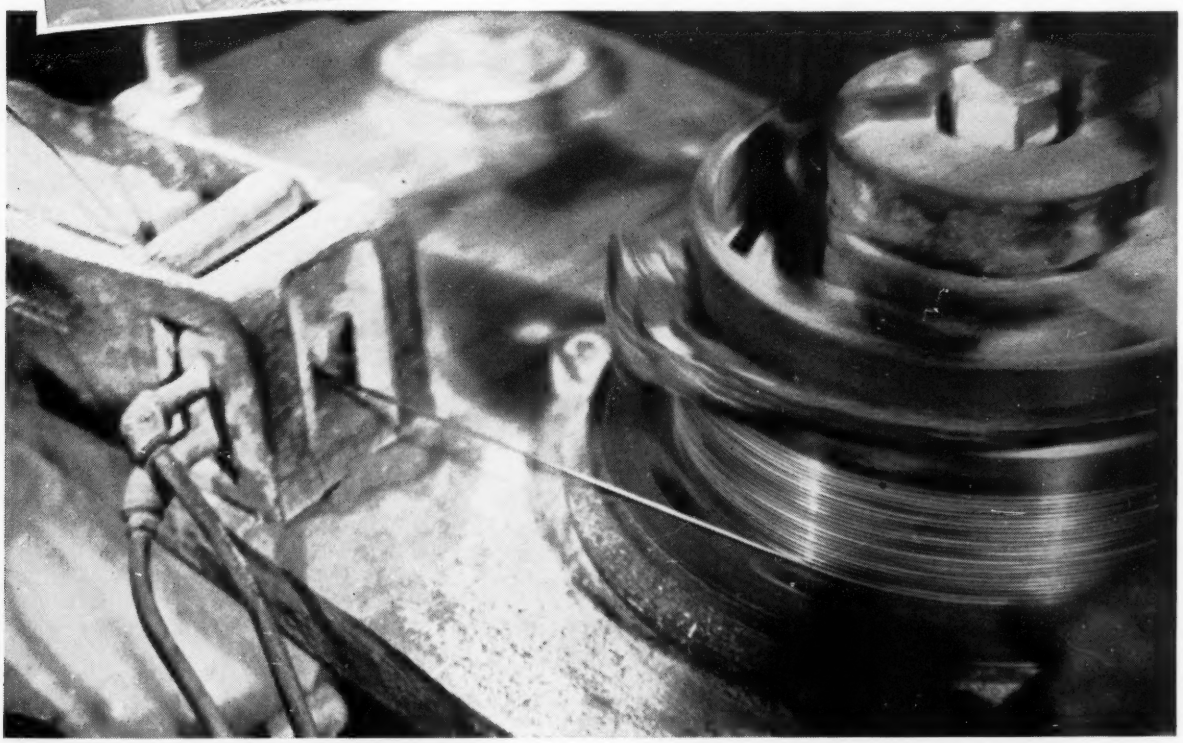
WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.



Morgan-Connor Wire Drawing Machines meet the exacting demands of present markets because their exclusive features afford high speeds with sustained production and uniformly high quality. Their unique high block design, unit control and air cooling system are major factors in establishing production on a profit basis. Morgan Construction Co., Worcester, Mass., U. S. A.

MORGAN-CONNOR



Continuous Wire Drawing Machinery

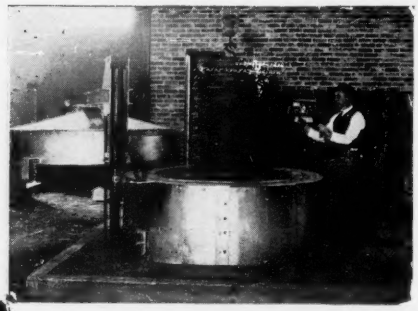
W28

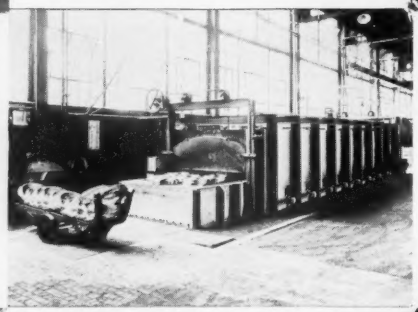
Sole European Representatives — Malmedie & Co., Dusseldorf, Germany

(Above) A special atmosphere continuous, roller hearth type electric furnace for bright annealing bronze, copper and nickel-silver wire and strip.

(Below) Three fuel fired pit type furnaces for normalizing and spheroidizing rod and bright annealing wire—another repeat order.

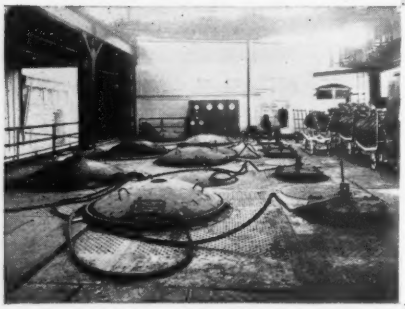
(Below) Gas fired, continuous conveyor type furnace for clean annealing brass and bronze wire in coils—capacity 5,000 lbs. per hour.



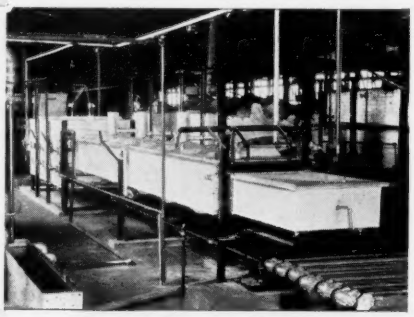


(Above) Special alloy rod is annealed without scale or decarburization in this electrically heated pit type furnace. One of several similar furnaces in a prominent plant.

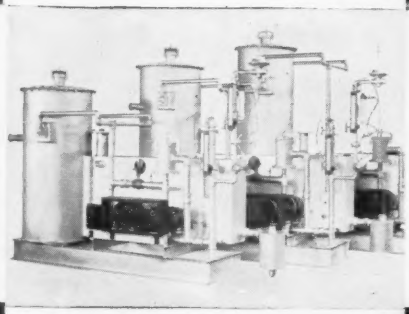
(Below) Bright annealing fine copper wire on spools — one of two similar controlled atmosphere installations we made in this plant.



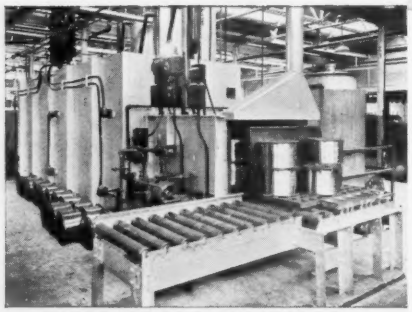
(Below) Three standard sizes of Elfurno generators for producing the inexpensive protective atmospheres used in controlled atmosphere furnaces. Elfurno generators are built for any capacity required.



(Below) A special atmosphere pusher type electric furnace for bright annealing both heavy and fine copper wire on large reels, on spools and in coils.



(Below) Another fuel fired, continuous, controlled atmosphere bright annealing furnace equipped with The Electric Furnace Company's new recuperative type gas fired radiant tubes.



We specialize on designing and building production furnaces and time and labor saving material handling equipment for use in connection with furnaces. Put your furnace and heat treating problems up to our experienced engineers.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production